CTSW-RT-05-157.04.02

CALTRANS LAKE TAHOE STORM WATER SMALL-SCALE PILOT TREATMENT PROJECT

Phase IV Final Report

April 2006

CALIFORNIA DEPARTMENT OF TRANSPORTATION
1120 N STREET
SACRAMENTO, CA 95826

Contents

APPENDICES

TABLES

FIGURES

Chapter 1

Executive Summary

Chapter 1 Executive Summary

The State of California Department of Transportation (Caltrans) is conducting the Lake Tahoe Storm Water Small-Scale Pilot Treatment Project to identify and evaluate storm water treatment technologies that may be capable of meeting the Tahoe Basin numeric surface water discharge limits for turbidity, total phosphorus, total nitrogen, total iron, and oil/grease. Presented in this report are the results from the fourth year (Phase IV) of the pilot testing program. Results of the first three years of testing can be found in Caltrans Document Numbers CTSW-RT-03-042, CTSW-RT-03-079.31.37, and CTSW-RT-05-069.04.07.

1.1 Background and Objectives

During the previous three phases of the small-scale pilot project, several potential storm water treatment options have been identified. Some of the most promising systems tested to date have all involved sedimentation and/or granular media filtration, with and without chemical assistance. The best-performing granular filter media identified to date is activated alumina, which is now being tested by Caltrans in full-scale pilot tests along Highway 50 in the South Lake Tahoe Area. Through jar and settling column testing, two chemical coagulants (PASS-C® and PAX-XL9®) have demonstrated effective turbidity removal over a range of chemical doses.

The overall purpose of the small-scale pilot treatment project continues to be the evaluation of storm water treatment methods that may be able to produce an effluent that complies with the numeric discharge limitations (see Table 2-1) and ultimately the load based (TMDL) regulations. The Phase IV testing objectives were:

1. To evaluate the hydraulic and treatment performance of various filter media, including media not previously tested, over extended periods of operation that simulate multiple years of full-scale operation.
2. To determine the treatment performance and effective dose range of various chemical coagulants using jar testing methods under various conditions of mixing and temperature.
3. To investigate turbidity and phosphorus removals versus settling time for selected chemical coagulants used in chemically-enhanced settling experiments.

1.2 Phase IV Activities and Operations

The Phase IV pilot plant activities included three major tasks. They were:

1. **Extended Run Filter Media Tests.** Eighteen, 4-inch granular media filter columns were operated to evaluate the effects of long-term operation on filter media performance. Nine different filter media in column pairs were tested over seven batch runs with different storm waters. Each filter run lasted an average of 6 days. Media tested were activated alumina (four different types), sand (two different types), limestone, and two iron based media (granular ferric hydroxide, GFH™ and Bayoxide® E-33, both proprietary).

2. **Jar Testing of Coagulants.** For seven separate storm waters, a series of jar test experiments was conducted to determine the dose range of product effectiveness. Six chemicals (PASS-C®, PAX-XL9®, Jenchem 1720, Sumalchlor 50®, and two anionic polyacrylamides [PAM] products Superfloc® A-100 and Soilfix IR®) and three different jar test conditions (standard mixing, limited mixing, and colder water temperature) were evaluated. The apparent best turbidity dose was determined by measuring the turbidity of the treated storm water after mixing, followed by fifteen minutes of settling.

3. **Chemically-Enhanced Settling Rate Experiments.** Settling experiments were conducted using seven different storm waters to evaluate the effectiveness of three different chemical coagulants (plus a no-chemical control). The chemicals tested were PAX-XL9®, Jenchem 1720 and Superfloc® A-100. The coagulant dose used in each tank was determined from the jar test results.

1.3 Summary of Findings

In Phase IV, a total of seven runs were completed, five with rain event runoff, two with snowmelt and one with combined rain/snowmelt runoff. Waters used for testing were generally representative of typical Tahoe Basin rain event runoff but contained lower concentrations of nutrients (nitrogen and phosphorus) than desired for testing the capabilities of the various pilot treatment technologies. The findings from each of the investigations are summarized below.

1.3.1 Extended Run Filter Columns

Iron modified activated alumina was the best performing filter media tested with respect to removal of turbidity, total phosphorus and total nitrogen. (Table 1-1); however, this media was prone to hydraulic failure and required extensive intervention to maintain flow. Filtration with iron-modified activated alumina tended to depress the pH of the storm water by 0.5 to 1 pH units.

Table 1-1. Summary of Extended Run Filter Media Performance

Media	Treatment Performance (Average Effluent Concentration)			Hydraulic Performance (Rank[b])
	Turbidity (NTU)	Phosphorus[a] (mg-P/L)	Nitrogen[a] (mg-N/L)	
Fe-Modified Activated Alumina	0.7	0.04	0.18	9
Existing Act. Alumina (28x48 mesh)	7.2	<0.03	0.27	8
Activated Alumina (28x48 mesh)	12.4	<0.03	0.27	6
Activated Alumina (14x28 mesh)	37.0	0.04	0.25	1
Granular Ferric Hydroxide	8.1	0.05	0.41	7
Bayoxide E-33 (Iron Oxide)	51.3	0.05	0.42	5
Existing Sand (F-105)	82.5	0.15	0.31	2
Limestone (#4 Limestone Sand)	82.4	0.16	0.43	3
Superior 30 Sand	88.7	0.16	0.47	4
Tahoe Basin Discharge Limit[c]	20	0.10	0.50	-

[a] as "Total" [b] Ranking relative to media tested, 1 = best, 9 = worst [c] For discharges to surface waters

The second best performing media, with respect to turbidity, total phosphorus and total nitrogen removal was the 28x48 mesh activated alumina, regardless of its condition and relative age (existing Phase III media or new media). This media also required considerable intervention to maintain flow; however, a similar propensity to hydraulic failure has not been noted to date in full-scale activated alumina pilot filters. Filtration with 28x48 mesh activated alumina increased the pH of the water by approximately 0.3 pH units. An increase in the dissolved aluminum level was observed with the new media, but not with the existing media tested. Apparently, aluminum leaching diminishes after extended use.

Larger grain size activated alumina (14x28 mesh) ranked fourth in overall contaminant removal, but was the best performing media from a hydraulic standpoint. This media may provide the best overall combination of treatment and hydraulic performance of the media tested. Although it did not reliably meet the numeric standards for surface water discharge, the 14x28 mesh activated alumina may be a good choice for meeting future load based limits (TMDL).

Granular ferric hydroxide™ (GFH) media performed well in contaminant removal, but not as good as the various activated alumina. The most significant disadvantage is that GFH decreases the storm water pH by an average of over 2 pH units. Several of the effluents were well below (outside of) the Basin Plan objectives for pH (i.e. 6.5 pH units). An increase in effluent dissolved aluminum was noted (likely due to the low pH). GFH media performed poorly hydraulically.

The proprietary Bayoxide® E-33 media performed slightly better than the sand or limestone media. No increase in iron was detected in the effluent. Hydraulically, this media was ranked in the middle with respect to the level of effort required to maintain flow. The remaining media (limestone, Superior 30 sand, and the existing F-105 sand) perform poorly with respect to contaminant removals (compared to the other media). Although these media were not able to meet the limits for discharge to surface waters they did accomplish substantial contaminant removals and are free from undesirable side effects (increased pH or aluminum levels).

1.3.2 Jar Test Experiments

Of the six chemicals tested, PASS-C®, PAX-XL9® and Jenchem 1720 were most effective in removing turbidity and phosphorus from the storm water. Jenchem 1720 slightly outperformed the others by removing turbidity to below 20 NTU for all storm waters tested and removed an average of 97.4% of the phosphorus. SumalChlor 50® was the least effective poly aluminum chloride chemicals tested (successful in reducing turbidity to 20 NTU in 2 of 7 tests after 15 minutes of settling). Of the polyacrylamide (PAM) products, Superfloc® A-100 was more effective (turbidity <20 NTU in 5 of 7 waters) than SoilFix IR® (turbidity never below 20 NTU).

Water temperature had little effect on the performance of the coagulants tested. However, elimination of slow mixing had a large effect on both final settled turbidity and the range of effectiveness after 15 minutes of settling. The performance gap closed somewhat after an additional 45 minutes of settling.

1.3.3 Chemically-Enhanced Sedimentation Experiments

In the sedimentation columns, Jenchem 1720 and PAX-XL9® were very effective in reducing turbidity to below the Tahoe Basin surface water discharge limit (20 NTU). Both chemicals required an average (n = 7) of 5.8 hours to reduce the turbidity of the storm water to less than 20 NTU. For all runs, the majority (80-90%) of turbidity removal occurred within the first hour.

The best performing PAM product (Superfloc® A-100) was only slightly better than the control in reducing turbidity. Superfloc® A-100 required an average of 50 hours (extrapolated) to reduce the turbidity to 20 NTU. Lack of a slow mix step and increased settling distance are possible reasons for the difference in effectiveness observed between the jar and settling experiments.

Both PAX-XL9® and Jenchem 1720 were able to reduce the total phosphorus concentration of the settled storm water to below the limit required for surface water discharge (0.1 mg-P/L) in six of seven runs. In all but one run, Jenchem 1720 reduced the total phosphorus concentration to below the reporting limit (0.03 mg-P/L) within 8 hours. PAX-XL9® reduced the total phosphorus concentration to below the reporting limit in five of seven runs within 8 hours. Superfloc® A-100 was able to reduce phosphorus to below 0.1 mg-P/L in only two of seven runs.

1.4 Potential Future Testing Activities

The following may be considered for future testing at the Lake Tahoe Storm Water Small-Scale Pilot Treatment Facility:

A. Granular Media Investigations

1. Testing of various pretreatment (prior to filtration) methods, filter media grain sizes, and filter loading rates. Because of site constraints in most roadway runoff situations, there is a need to develop higher hydraulic rate and smaller foot-print filters than those currently being implemented on a full-scale basis. To sustain higher filter loading rates, larger grain sizes and improved pretreatment methods should be considered.
2. Identification and testing of new alternate media that may be suitable for storm water filtration.
3. Evaluation of the utility of layering different types of sorptive media to mitigate undesirable treatment effects (i.e. increased effluent pH and aluminum levels).
4. Evaluation of the benefits of using sand caps on top of other filter media. Sand caps have been used in the filters tested to date, but they have not been completely successful in protecting the underlying media from fouling.

B. Chemical Treatment of Storm Water

1. Study the settling characteristics of chemically-enhanced storm water at doses other than optimal. Many of the polyaluminum chloride coagulants have a wide range of effectiveness, but little is known about the performance at the fringes of treatment.
2. Conduct additional assessments of the potential aquatic toxicity of chemical treatment. Multi-species toxicity testing of chemically-treated storm water (various chemicals) and resultant solids residues would be useful.
3. Investigation of streaming current detection as an indicator of appropriate chemical dose.
4. Particle size investigations to help in the understanding of turbidity and other contaminant removal mechanisms.

Chapter 2

Introduction

Chapter 2 Introduction

In 2001, the State of California Department of Transportation (Caltrans) initiated the Lake Tahoe Storm Water Small-Scale Treatment Pilot Project to evaluate storm water treatment technologies specifically for highway runoff in the Lake Tahoe Basin. The pilot project is a multi-year program, and this report covers the fourth year (Phase IV) of pilot operations. The background and purpose of the project, previous studies and reports, the objectives and scope of the Phase IV work, and the organization of this report are discussed briefly in this chapter.

2.1 Background

The Lahontan Regional Water Quality Control Board (LRWQCB) has adopted numerical storm water effluent limits as part of the Tahoe Basin Plan (LRWQCB, 1994). Numerical discharge limits for total nitrogen, total phosphorus, iron, turbidity and oil and grease vary depending on whether the discharge is directly to a surface water body or to an infiltration type treatment system (Table 2-1). As part of the Lake Tahoe Basin Regional Water Quality Management Plan ("208 plan"), the Tahoe Regional Planning Agency (TRPA) adopted similar storm water effluent limits, except that the nitrogen, phosphorus and iron limitations are based on dissolved fractions rather than total concentrations. Also, for discharge to surface water, TRPA plans to regulate total suspended solids (TSS) in lieu of turbidity.

Table 2-1. Numeric Storm Water Runoff Discharge Limits

Constituent	Units	Maximum Effluent Concentration			
		Discharge to Surface Waters		Discharge to Infiltration Systems	
		Lahontan	TRPA	Lahontan	TRPA
Total Nitrogen	mg-N/L	0.5	-	5	-
Dissolved Nitrogen	mg-N/L	-	0.5	-	5
Total Phosphate[a]	mg-P/L	0.1	-	1	-
Dissolved Phosphate	mg-P/L	-	0.1	-	1
Total Iron	mg/L	0.5	-	4	-
Dissolved Iron	mg/L	-	0.5	-	4
Turbidity	NTU	20	-	200	-
Suspended Sediment	mg/L	-	250	-	[b]
Oil and Grease	mg/L	2	2	40	40

[a] Basin plan specifies that total phosphate is measured as "total phosphorus" (LRWQCB, 1994).
[b] Not specified

In 2008, the discharge limits listed in Table 2-1 will apply to all storm water runoff from developed and disturbed areas within the California portion of the Basin, including runoff from Caltrans facilities. At some point, however, storm water regulations are expected to shift from concentration-based limits to pollutant load-based regulations. In the next few years, Total Maximum Daily Load (TMDL) guidelines are expected. TMDL guidelines are expected to be specific to the location and tributary receiving roadway runoff.

2.2 Previous Studies

Brief highlights of the first three years of the Caltrans Lake Tahoe Storm Water Small-Scale Pilot Treatment Program are summarized below.

2.2.1 Phase I

The first year activities of the small-scale pilot project (Phase I, 2001/2002 wet season) consisted of plant construction, laboratory jar testing of coagulants and testing the efficacy of several “non-mechanized” and “mechanized” treatment technologies. Treatment systems were operated 6 times in Phase I with 6 different storm waters. Non-mechanized systems included various combinations of sedimentation, with and without chemical assistance, and granular media filtration. Both inert and adsorptive filter media were tested, including fine, coarse and concrete sand; aluminum oxide; activated alumina; and zeolite. Based on evaluation of Phase I data, the non-mechanized filtration systems (with the possible exception of filtration with activated alumina media), when used without prior chemical addition and sedimentation, were ineffective at meeting numerical surface water discharge limits for storm water in the Tahoe Basin. The aluminum oxide and zeolite media did not appear to offer any treatment advantages above that observed with fine sand filtration. In some runs, the activated alumina filtration media demonstrated effective removal of dissolved phosphorus.

Mechanized systems that were investigated in the first year included a proprietary high-rate coagulation/flocculation/ballasted-sedimentation process (Actiflo®), followed by a proprietary high-rate synthetic media filter (Fuzzy Filter®) and ion exchange columns. A conventional pressure sand filter was also tested as an alternative to the Fuzzy Filter®. The mechanized treatment systems were tested on 5 occasions in Phase I with different storm waters. In general, the mechanized systems were effective in meeting most of the numerical limits for surface water discharge, with most of the treatment occurring in the initial treatment step (Actiflo®).

2.2.2 Phase II

The second year of the small-scale pilot treatment program (2002/2003 wet season) involved continued testing of both non-mechanized and mechanized treatment systems (6 experimental runs using different storm waters). In Phase II, a key objective was to investigate means of improving performance of the non-mechanized systems. Toward this end, additional filter media were tested, including limestone, expanded shale, and wollastonite. Also, longer sedimentation times (24 hours versus 2 hours, without chemicals), slower filter loading rates, and the use of submerged filter media were tested. Chemical coagulation was investigated further in Phase II, including jar testing to determine performance as a function of dose and to evaluate correlations between influent turbidity and optimal dosing. A conventional coagulation / flocculation / sedimentation process was evaluated and compared to the proprietary high-rate Actiflo® system.

It was generally found that the increased sedimentation times and submerged filter media had small positive effects on treatment performance for the non-mechanized sedimentation/filtration systems. The positive effects of slow filter loading rates were much more substantial. Chemically-assisted sedimentation using either PASS-C® or liquid chitosan (Liqui-Floc™) was found to be quite effective, meeting or nearly meeting the regulatory requirements for surface water discharge, while sedimentation without chemicals was not effective in meeting the requirements. Sedimentation without chemicals followed by filtration through activated alumina or expanded shale was found to almost always meet all requirements for surface water discharge. Limestone media was somewhat less effective, and wollastonite was not effective. However, wollastonite was only tested in two runs. Activated alumina was found to contribute dissolved and acid soluble aluminum to the treated storm water and raise the pH. Treatment with expanded shale and limestone media also resulted in elevated pH values.

Optimized dosing of PASS-C® based on jar test experiments was found to provide minimal improved treatment performance as compared to using a fixed dose of 100 mg/L. It was also found that optimum doses were higher for both low and high influent storm water turbidities, while being lower for mid-range (100 to 400 NTU) turbidities.

In Phase II, both the proprietary and non-proprietary mechanized treatment systems always met all of the requirements for surface water discharge.

2.2.3 Phase III

After Phase II, it was clear that some of the non-mechanized granular media filters had potential, but questions remained about filter loading rates, hydraulic performance, media viability and expected lifetime in the field. Because two of the media tested in Phase II arrived too late for a full evaluation to be made, some limited additional testing of limestone and wollastonite was desired. In both Phases I and II, chemical addition was shown to be effective; however, additional data was needed to determine the best choice of coagulant and dose, and sensitivity to mixing and settling time.

1. In Phase III, four additional runs using the existing 30-inch limestone and wollastonite filters (following 24-hour sedimentation) were made. Both of these filter media were unable to consistently meet the limits for surface water discharge. The Phase III results provided confirmation that limestone is more effective in treating Tahoe Basin storm water than wollastonite. However, based on the Phase II data for similar experiments, limestone is less effective than activated alumina.

2. To test the long-term effectiveness of adsorptive media, 4-inch diameter filter columns were constructed and then operated on a 5-day-on, 2-day-off schedule for 12 weeks. Granular filter media tested included activated alumina, fine sand, lanthanum-coated diatomaceous earth, and expanded shale (duplicate columns). Activated alumina was the most effective media for the removal of phosphorus and turbidity; however, the activated alumina media was prone to frequent hydraulic failures (plugging). None of the media were able to consistently attain the Tahoe Basin surface water discharge limit for total nitrogen. Elevated concentrations of dissolved aluminum in the effluents of the activated alumina and expanded shale filters were noted.

3. The ability of water treatment chemicals (coagulants) to reduce turbidity and phosphorus from storm water was studied further using: 1) traditional jar testing and 2) 220-gallon sedimentation tank runs. These studies generally showed that PASS-C® and PAX-XL9® (both polyaluminum chloride formulations) were consistently better than Liqui-Floc™ (a naturally occurring polymer formulation) in reducing turbidity and phosphorus concentrations. Valuable data regarding the range of doses resulting in effective treatment were collected. A fixed dose of 100 mg/L of PASS-C® and PAX-XL9® was generally near the optimal dose for the 10 storm water/snowmelt waters tested. In experiments using the 220-gallon sedimentation tanks, chemically-enhanced sedimentation with both PASS-C® and PAX-XL9® was able to reduce the turbidity to below the 20 NTU benchmark in approximately 2 to 6 hours when dosed optionally.

2.2.4 Previous Reports

Studies conducted at the Lake Tahoe Storm Water Small-Scale Pilot Treatment Project have resulted in the generation of the following Caltrans reports:

1. Lake Tahoe Storm Water Treatment Pilot Project Monitoring and Operations Plan, CTSW-RT-01-054, dated March 2002.

2. Lake Tahoe Storm Water Small-Scale Pilot Treatment Project Phase II Monitoring and Operations Plan, CTSW-RT-03-053.33.41, dated May 2003.

3. Lake Tahoe Storm Water Treatment Pilot Project Jar Test Results and Summary Report, CTSW-RT-02-075, dated June 2003.

4. Lake Tahoe Storm Water Small-Scale Pilot Treatment Project First Year Report, CTSW-RT-03-042, dated August 2003.

5. Caltrans Lake Tahoe Storm Water Small-Scale Pilot Treatment Project Phase II Report, CTSW-RT-03-079.31.37, dated December 2003.

6. Caltrans Lake Tahoe Storm Water Small-Scale Pilot Treatment Project Phase III Monitoring and Operations Plan, CTSW-RT-04-069.04.04, dated June 2004.

7. Caltrans Lake Tahoe Storm Water Small-Scale Pilot Treatment Project Phase III Report, CTSW-RT-05-069.04.07, dated May 2005.

8. Caltrans Lake Tahoe Storm Water Small-Scale Pilot Treatment Project Phase IV Monitoring and Operations Plan, CTSW-RT-05-069.04.08, dated January 2005.

The *Caltrans Lake Tahoe Storm Water Small-Scale Pilot Treatment Project - Phase IV Monitoring and Operations Plan* (hereinafter referred to as the "M&O Plan" throughout this document) includes detailed descriptions of pilot plant construction, operation, monitoring and sampling for the work discussed in this document. The Monitoring and Operations Plans for previous project phases include additional descriptions of the pilot facilities. The reader is referred to these documents for a full description and understanding of plant processes and sampling activities.

2.3 Phase IV Objectives and Approach

The objectives and approach for Phase IV of the small-scale pilot treatment program are discussed briefly below.

2.3.1 Phase IV Objectives

The overall purpose of the small-scale pilot treatment project continues to be the evaluation of storm water treatment methods that may be able to produce an effluent that complies with the numeric discharge limitations (summarized in Table 2-1) and ultimately the load based (TMDL) regulations. The Phase IV project objectives were developed to build upon the knowledge derived from previous efforts and to address issues and data gaps identified from Phases I through III. The Phase IV testing objectives were:

1. To evaluate the hydraulic and treatment performance of various filter media, including media not previously tested, over extended periods of operation that simulate multiple years of full-scale operation.

2. To determine the treatment performance and effective dose range of various chemical coagulants using traditional jar testing methods under various conditions of mixing and temperature.

3. To investigate turbidity and phosphorus removals versus settling time for selected chemical coagulants in chemically-enhanced settling experiments.

2.3.2 Phase IV Approach

The Phase IV approach included three major activities, devised to accomplish the objectives listed above. They were:

1. **Four-Inch Filter Column Runs.** Eighteen, 4-inch granular media filter columns were tested to evaluate the effects of long-term operation on filter media performance. Nine different filter media in column pairs were tested with settled storm water on a batch experimental basis (7 runs). For each run, fresh storm water runoff was collected during rain or snow melt events, trucked to the pilot facility, kept in a mixed storage tank, and metered through the filters. Each filter run lasted an average of 6 days. Media tested were activated alumina (4 different types), sand (2 different types), limestone, granular ferric hydroxide™ and Bayoxide® E-33 (both proprietary iron based media). As in Phase III, a flow-through clarifier was used to provide a constant source of settled storm water to the 4-inch filter columns.

2. **Jar Testing.** For seven different storm waters, a series of jar-test experiments was conducted to determine the dose range of product effectiveness. Six chemicals (PASS-C®, PAX-XL9®, Jenchem 1720, Sumalchlor 50®, and two anionic polyacrylamides (PAM) products [Cytec Superfloc® A-100 and Soilfix IR®]) and three different jar test conditions (standard mixing, limited mixing, and standard mixing combined with colder water temperatures) were evaluated. The apparent best turbidity dose was determined by measuring the turbidity of the treated storm water after mixing, followed by15

minutes of settling. After one hour of settling, turbidity was again measured and some jars were tested for total and dissolved phosphorus.

3. **Chemically-Enhanced Settling Rate Experiments.** Settling experiments were conducted using seven different storm waters to evaluate the effectiveness of three different chemical coagulants (plus a no-chemical control). The chemicals tested were PAX-XL9®, Jenchem 1720 and Cytec Superfloc® A-100. For each chemical, one 220-gallon, 30-inch diameter sedimentation tank was filled with dosed storm water and allowed to settle for an 8-hour period. Samples were collected at various times from sampling ports situated at two different depths and analyzed for total and dissolved phosphorus and turbidity. The coagulant dose used in each tank was determined from the jar test results.

The configuration and operation of pilot treatment systems and facilities to accomplish the testing program developed for Phase IV are discussed in detail in the M&O Plan and are briefly summarized in Chapter 3. Also included in the Phase IV M&O Plan is a stand alone Sampling and Analysis Plan (SAP) covering all aspects of sample collection and data handling.

2.4 Organization of this Report

This report is organized into six chapters. Chapter 1 contains an Executive Summary of the Phase IV work. Chapter 2 includes an introduction and background information for the project. Chapter 3 contains an overview of the pilot facilities and operations, including brief descriptions of the treatment units, storm water collection procedures, and sampling. Chapter 4 contains operational summaries for all of the Phase IV investigations. Chapter 5 contains project results and data analyses. A summary of findings and recommendations are included in Chapter 6. Following Chapter 6 is a list of references. Detailed data and graphs referenced in the various sections are included in the Appendices. Included as Appendix A is a summary of the quality control procedures used to evaluate and verify the data collected in Phase IV.

Chapter 3

Facilities and Procedures

Chapter 3 Facilities and Procedures

An overview of the facilities, equipment, and procedures used at the Caltrans Lake Tahoe Small-Scale Storm Water Pilot Treatment in the fourth year are presented in this chapter. Phase IV pilot plant activities included three key components:

1. Operation of 4-Inch Filter Columns
2. Collection of Coagulant Dose vs. Turbidity Data (Jar Test Experiments)
3. Chemically-Enhanced Settling Rate Experiments

Each component of the work is discussed separately below. Text and tables are presented to describe how the treatment units and experiments were configured, sampled and operated. Deviations from the procedures and equipment described in the M&O Plan are listed. To aid in the interpretation of results, included in this chapter is a brief reiteration of the sampling locations, frequency, sampling procedures and handling requirements.

3.1 Storm Water Collection and Monitoring

The storm water collection and on-site storage and handling procedures were as outlined in the M&O Plan and are the same as those used in previous project phases. Specific details of the waters collected in Phase IV are described in Section 4.1 of the next chapter. Pertinent general information and site descriptions are presented below.

3.1.1 Storm Water Collection and Sampling Locations

Storm water runoff was collected from basins and vaults located within the Tahoe Basin. Water was pumped from these sites and hauled by truck to the pilot facility. Pilot plant personnel supervised the collection of storm water runoff. Storm water was collected from basins during active rainfall or as soon as possible after significant runoff had occurred; however, due to safety constraints, storm water was not collected at night or after sunset. Storm water was typically collected within 1-14 hours of the start of the rain event.

Storm water collection sites used in this Phase IV and previous phases were selected based on access and safety, available volume, and because the primary contribution is edge of pavement roadway drainage. Summarized in Table 3-1 for each site used are the assigned site number, the type of detention structure and a description of the site. A general map of the storm water collection sites is shown in Figure 3-1. Because of a lack of medium to high turbidity run off in some of the basins, storm water was not collected from all of the six collection locations described. The on-site detention basin and the Highway 89 (HY-89) basin were the primary source of water used in Phase IV (see Section 4.1).

Table 3-1. Storm Water Sampling Site Locations

Site Number	Structure	Location/Description	Used in Phase IV
1	Jensen Box	Southwest corner at the intersection of Pioneer Trail and Al Tahoe Blvd., South Lake Tahoe, CA. Box is situated approximately 5 feet from the paved bike lane. Runoff contributions from curb and gutter only. Storm water collected from the first cell.	Yes
2	Jensen Box	West side of 12th Street at the intersection of Patricia St. South Lake Tahoe, CA. Box is situated alongside a foot trail approximately 10 feet off the roadside. Runoff contributions from curb and gutter only. Storm water collected from the first cell.	No
3	Detention Basin	West side of Highway 89 (Emerald Bay Road) at the 4 lane to 2-lane transition, just outside of the South Lake Tahoe City limits. Runoff contributions primarily from Highway 89 only. Storm water runoff collected by lowering a suction line off the bottom and draining most of the basin.	Yes
4	Detention Basin/Pond	Caltrans Snow Storage Yard, located at the end of Sierra Boulevard in South Lake Tahoe, CA. Runoff primarily from melting snow mounded in the yard. Water collected from the first pond, alongside the northwest access road as close to the influent stream as possible.	No
5	Detention Basin/Pond	Northeast corner of the intersection of Ski Run Blvd. and Osgood St., South Lake Tahoe, CA. Basin is a concrete lined inlet forebay to a flood control/storm water treatment basin/wetland. Contributions to the basin are primarily from city streets. Water collected at the inlet pipe.	Yes
6	Detention Basin	On-site detention basin located on the South Lake Tahoe Maintenance Station (2243 Cornelian Drive, Meyers, CA) property, adjacent to the pilot storm water treatment building. Contributions to the basin are from surface water runoff from the maintenance yard and from snowmelt. Water collected by lowering a pump suction line (off of the basin bottom) and pumping directly up to the pilot plant storage tanks.	Yes

3.1.2 Storage, Mixing and Use

Storage and Mixing: After collection, storm water was stored in one of two on-site 4,500-gallon (17,000-liter) polyethylene Baker® tanks. Submersible ABS mixers situated inside the tanks were operated continuously, as long as the storm water was being stored or used (see M&O Plan).

Use: In Phase IV, the storm water was used in a similar manner as in previous studies. To feed the 4-inch filter columns, the storm water being mixed in the Baker tank was continuously pumped into a clarifier. From the clarifier, the water flowed by gravity into the building where peristaltic pumps were used to feed the columns. For the chemically-enhanced sedimentation experiments, storm water was pumped directly from the Baker tank into one the several 220-gallon sedimentation tanks.

The water in the Baker tank was used for the experiments mentioned above until the experimental run was over. Daily monitoring requirements of the stored storm water are described in Section 3.1.3. After use, any storm water remaining in the Baker Tank was released to the on-site detention basin.

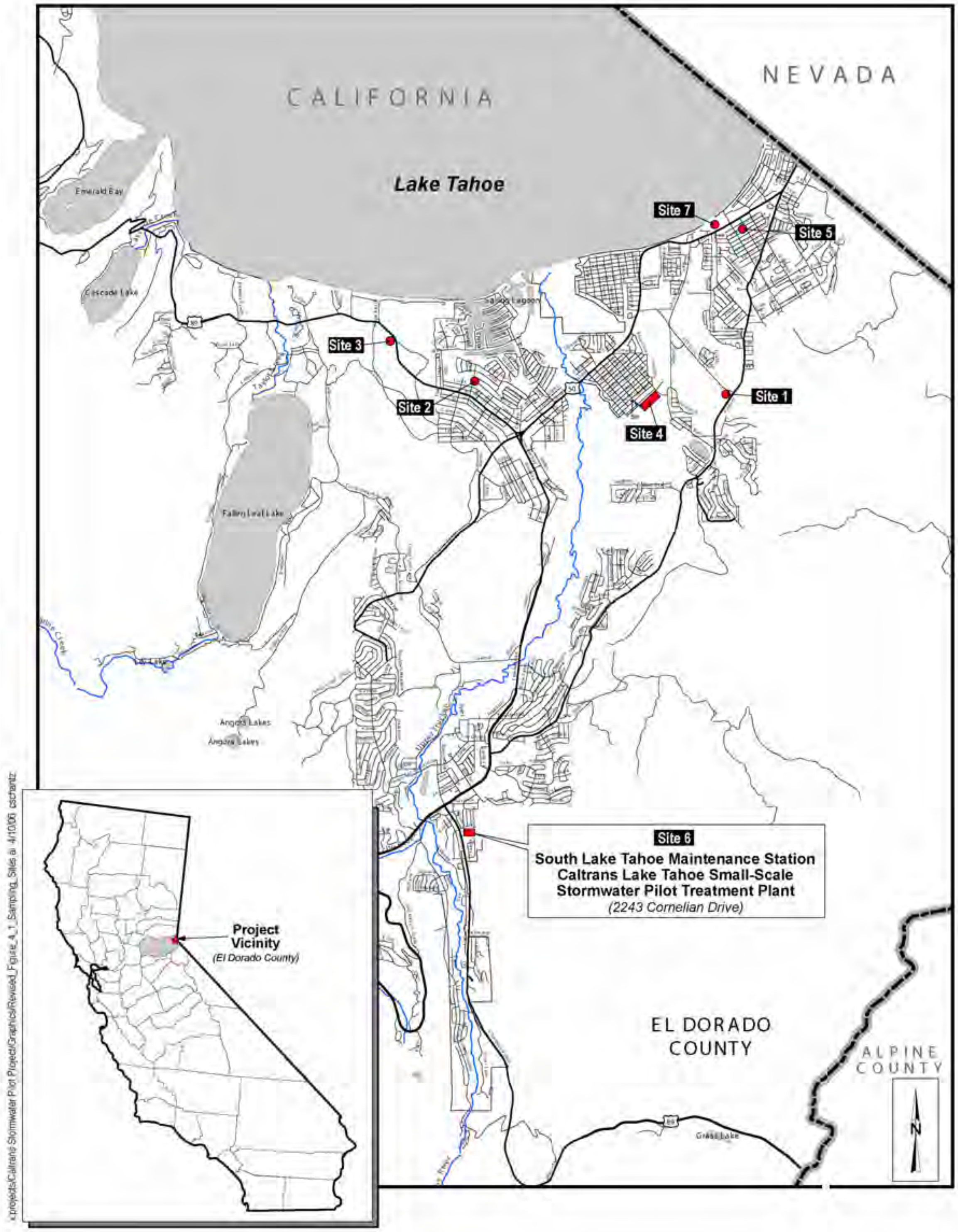


Figure 3-1. Storm Water Collection Sites

3.1.3 Storm Water Sampling and Monitoring (Baker Tank)

After collecting storm water and filling a Baker tank, a single influent sample was collected for water quality (WQ) determinations. This sample was collected by opening the lower valve on the Baker tank and filling a “clean” 5-gallon sample collection bucket (with liner). This sample was processed immediately after collection. Sample processing activities included splitting the sample into multiple sample containers, filtering for dissolved analyses, labeling bottles and completing chain-of-custody forms. To minimize environmental contamination of the samples during sample processing, a clean hands/dirty hands procedure was used. Sample processing details are provided in the M&O Plan. The influent “Baker Tank” sample was analyzed for the parameters using the methods and reporting limits listed in Table 3-2.

An “influent settling test” was run daily to determine if the storm water being held in the exterior Baker tank retained its original settling characteristics. Each day, a 2-L influent sample was collected into a jar test beaker. The turbidity of the sample was measured every hour for an 8-hour period. This procedure was followed daily for the duration of each experimental run. At the end of each day the settling rate (turbidity vs. time) was graphed and if a change in the rate curves was observed, the run would be terminated and use of the water discontinued (see M&O Plan).

3.1.4 Storm Water Phosphorus Addition

After the relative absence of dissolved phosphorus in the first few experimental runs, the raw storm water in the Baker tank was spiked with phosphorus, if needed, to increase the level of dissolved phosphorus for subsequent runs. This information is not in the M&O Plan. The procedures established were as follows:

- A sample of the bulk storm water was collected and either sent to the analytical laboratory for immediate phosphorus analysis (excluding weekends) or tested at the Pilot Facility using a field phosphorus test kit (Hach® Total Phosphate Test Kit, Model PO-24) to determine the concentration of dissolved phosphorus (typical).
- If the concentration of dissolved phosphorus was less than 0.07 mg-P/L, then a solution of sodium phosphate was added to the storage tank to increase the dissolved phosphorus concentration to approximately 0.1 mg-P/L. To accomplish this, a solution containing 7.8 g of sodium phosphate dibasic anhydrous (Fisher® Brand, Certified ACS Grade, S374-500) dissolved in 4L of warm water was added to the 4,500 gallon storage tank.

3.2 4-Inch Extended Run Filter Columns

A series of 4-inch filter columns was tested in Phase IV to evaluate the effects of long-term operation on filter media performance. A flow-through clarifier (38 gpd/ft^2 overflow rate) provided a constant source of settled storm water to the 4-inch columns. Eighteen columns containing nine different media were tested. Storm water was collected after a rainfall event or a significant snowmelt event. Columns were typically operated for 6-7 days unless early failure occurred (see Section 4.4.2).

Table 3-2. Phase IV Water Quality Parameters, Reporting Limits and Analytical Methods Used

Field Determinations					
Parameter	**Abbreviation**	**Reporting Limit[c]**	**Units**	**Analytical Method[a]**	
Specific Conductance	EC	1	μmhos/cm	EPA 120.1	
pH	pH	0.1	S.U.[b]	EPA 150.1	
Turbidity	Turb	0.1	NTU	EPA 180.1	
Temperature	Temp	1	°C	EPA 170.1	
Laboratory Determinations					
Parameter	**Abbreviation**	**Required Reporting Limit**	**Units**	**Analytical Method [d]**	**Holding Time**
Alkalinity – Total	Alk-T	1	mg-$CaCO_3$/L	EPA 310.1	14 days
Total Suspended Solids	TSS	1	mg/L	EPA 160.2	7 days
Volatile Suspended Solids	VSS	1	mg/L	EPA 160.4	7 days
Nitrate + Nitrite Nitrogen	NO_3+NO_2	0.1	mg-N/L	EPA 353.2	28 days
Total Kjeldahl Nitrogen (Filtered)	TKN-D	0.1	mg-N/L	EPA 351.3	28 days
Total Kjeldahl Nitrogen (Un-Filtered)	TKN-T	0.1	mg-N/L	EPA 351.3	28 days
Total Phosphorus (Filtered)	Phos-D	0.03	mg-P/L	EPA 365.2	28 days
Total Phosphorus (Un-Filtered)	Phos-T	0.03	mg-P/L	EPA 365.2	28 days
Aluminum – Total	Al-T	25	μg/L	EPA 200 (.7 or .8)	180 days
Aluminum – Dissolved	Al-D	25	μg/L	EPA 200 (.7 or .8)	180 days
Aluminum – Acid Soluble	Al-AS	25	μg/L	EPA 200 (.7 or .8)[e]	180 days
Iron – Total	Fe-T	25	μg/L	EPA 200.7	180 days
Iron – Dissolved	Fe-D	25	μg/L	EPA 200.7	180 days
Total Organic Carbon	TOC	1	mg/L	EPA 415.1	28 days

Notes:
[a] To the extent possible, EPA methodology will be followed in the field
[b] S.U. = Standard Units
[c] Refers to instrument resolution
[d] EPA = EPA Methods for Water Analysis
[e] Acid soluble extraction, see EPA 440/5-86-008

Media evaluated include activated alumina (AA), Superior 30 sand (S30), fine sand (F-105), #4 limestone sand (LS), iron modified activated alumina (FeAA), granular ferric hydroxide® (GFH), and Bayoxide E-33® (both are proprietary iron based media. Note: that both are registered trademarks and the use of the symbol will be discontinued from this point forward). In this section, the 4-inch columns, media used, column designations, setup and conditioning activities are briefly discussed.

3.2.1 Description of the 4-Inch Filter Columns

The filter columns were constructed of 4-inch (15.2 cm) diameter clear PVC pipe with unions to allow access to the media and gravel support material (Figure 2-1 in the M&O Plan). Each column contained 24-inches (61 cm) of filter media over 5 inches (13 cm) of gravel. A piece of geotextile fabric (Amoco 4546, non-woven) fitted around a PVC retainer ring was placed between the media and the gravel layer. A 6-inch (15 cm) layer of Superior 30 sand was placed on top of the media as a protective cap that could be removed and replaced upon excess headloss buildup, without disturbing the media below.

Settled storm water was introduced into the filter by pumping water over the top of the column and down into a ½” PVC manifold that rested on the filter surface. Filter effluent exited from the bottom of the column via piping and tubing from a perforated, inverted PVC cap placed on the bottom to support the underdrain gravel. Sample ports were situated at 6-inch (15 cm) intervals through the media as shown in Figure 2-1 in the M&O Plan. The outlet tubing for the filter effluent and each of the sample ports was extended to 1 inch (2.5 cm) above the media surface to maintain the filter media in a submerged condition. Additional information on the 4-inch filter columns can be found in the M&O Plan.

The 4-inch columns were loaded with storm water that was settled first in the collection basin and again in a flow-through clarifier for approximately 24 hours. The clarifier was fabricated from a cylindrical 100-gallon (380 L) polyethylene tank (27”W x 42”H) and was situated outside the pilot treatment building next to the influent storm water holding tank (Baker tank). Mixed storm water from the Baker tank was pumped through a basket strainer (1/16” perforations) and into the clarifier continuously during each run. Water exited the clarifier via an overflow standpipe (1/2” PVC) and flowed by gravity through a sloped pipe into the building to a sump.

A series of peristaltic pumps were used to pump settled storm water from the clarifier outlet sump to the 4-inch filter columns. Each peristaltic pump drive was fitted with three variable occlusion pump heads and used to feed three columns. The target-loading rate was 20.6 mL/min per column, which was equivalent to a filter-loading rate of 12 ft/day (3.65 m/day).

Column numbering, media and source are presented in Table 3-3. Media were placed in Columns 5-18 on November 15, 2004. The media in Columns 1-4 were pre-existing from Phase III.

Between Experimental Runs 19 and 20, a small 24-inch column containing 12 inches of #4 limestone sand was constructed to polish the effluent from Column 6 (that contained 28x48 mesh AA). This “limestone polishing” column is not described in the M&O Plan. The purpose of this column was to determine if the limestone media removed any excess dissolved aluminum in the effluent of the new activated alumina filter column. This polishing column was a 24-inch high, 4-inch diameter PVC column constructed similar to the larger filter columns. This polishing column was situated under the effluent outfall of Column 6 and monitored for turbidity and dissolved aluminum only.

Table 3-3. Filter Media Used in the 4-Inch Filter Columns and Product and Vendor Information

Column #	Filter Media	Product and Vendor
1 & 2	Activated Alumina (Existing 28 x 48 DD-2 from PIII)	Alcoa DD-2 28 x 48 Schoofs, Inc Los Angeles, CA Tel. (925) 376-7311
3 & 4	Fine Sand (Existing F-105 from PIII)	F-105 Filter Sand (Lapis) Loprest Water Treatment 2825 Franklin Canyon Road Rodeo, CA, 94572 Tel. (888) 228-5982
5 & 6	Activated Alumina (New, 28 x 48 mesh DD-2)	Alcoa DD-2 28 x 48 Schoofs, Inc
7 & 8	Activated Alumina (Alternate Mesh) (New, 14 x 28 mesh DD-2)	Alcoa DD-2 14 x 28 Schoofs, Inc
9 & 10	Superior 30 Sand (New)	Superior 30 Filter Sand Loprest Water Treatment
11 & 12	Limestone (New, Limestone #4)	Limestone #4 Sand Teichert Aggregates 3500 American River Drive Sacramento, CA Tel. (916) 296-4410
13 & 14	Iron Modified Activated Alumina (New, Actiguard AAFS-50, 28 x 48 mesh)	Alcan Specialty Aluminas 6150 Parkland Boulevard Cleveland, OH Tel. (440) 460-2600
15 & 16	Granular Ferric Hydroxide (New, GFH, 0.2-0.3 mm grain size)	U.S. Filter 1728 Paonia Street Colorado Springs, CO Tel. (719) 622-5322
17 & 18	Iron Oxide (New, Bayoxide E33)	Severn Trent Services 21520 Yorba Linda Boulevard Yorba Linda, CA Tel. (714) 692-9384

3.2.2 Filter Media

Media Physical Properties

Each column contained approximately 0.17 ft^3 (4.9 L) of media. Each media was conditioned prior to use by placing bulk media in a clean 5-gallon bucket and rinsing it with tap water. Media was rinsed until the supernatant water became clear. Media samples were collected before and after conditioning for sieve analyses. Results of the sieve analyses are shown in Table 3-4.

Table 3-4. Properties of Filter Media Used in the 4-Inch Filter Columns

Column #	Filter Media	Effective Size (D_{10}, in mm)		Uniformity Coefficient (D_{60}/D_{10})	
		Before Conditioning	After Conditioning	Before Conditioning	After Conditioning
1 and 2	Activated Alumina (Existing 28x48 DD-2 from PIII)[a]	0.311	0.324	1.50	1.45
3 and 4	Fine Sand (Existing F-105 from PIII)[a]	0.465	0.463	1.49	1.48
5 and 6	Activated Alumina (28x48 mesh DD-2)	0.301	0.420	1.67	1.66
7 and 8	Activated Alumina (Alternate Mesh) (14x28 mesh DD-2)	0.468	0.459	1.96	1.77
9 and 10	Superior 30 Sand	0.217	0.227	1.88	1.86
11 and 12	Limestone (Limestone #4)	0.139	0.467	8.99	3.15
13 and 14	Iron Modified Activated Alumina (Actiguard AAFS-50, 28x48 mesh)	0.335	0.344	1.55	1.53
15 and 16	Granular Ferric Hydroxide (GFH, 0.2-0.3 mm grain size)	0.188	0.187	4.29	4.26
17 and 18	Bayoxide E-33 (iron oxide)	0.455	0.320	2.51	3.34

[a] Particle size distribution data from Phase III

Changes in media particle size distribution due to conditioning were generally small, except for the limestone. The limestone media required extensive rinsing before the water cleared. The effective size (D_{10}) of the limestone went from 0.139 mm before conditioning to 0.467 mm after conditioning. The uniformity coefficient (D_{60}/D_{10}) of the limestone was 8.99 before conditioning and 3.15 after.

A few selected media were sent out for pore size and surface area determinations (Table 3-5). The analyses were performed by Micromeritics Analytical Services (MAS), Norcross, GA on media samples after conditioning. Surface area analysis is a measurement of the exposed surface of a solid substance on the molecular level. The BET method was used by MAS to obtain the results in Table 3-5. The pore size analysis used by MAS was mercury intrusion porosimetry. Pore size results displayed in Table 3-5 are the median pore diameter expressed in volume for each media. Samples were degassed at 200 ºC for 4 hours prior to the analytical measurements.

Table 3-5. Surface Area and Pore Size Properties of Selected Filter Media (After Conditioning)

Col #	Filter Media	Effective Size. (D_{10}) (in mm)	Uniformity Coefficient (D_{60}/D_{10})	Surface Area (N_2 adsorption) BET Method (m^2/g)	Pore Size (Hg Intrusion)	
					Pore Dia. (μm)	Porosity (%)
5 and 6	Activated Alumina (28x48 mesh DD-2)	0.420	1.66	288	47.08	61.02
7 and 8	Activated Alumina (14x28 mesh DD-2)	0.459	1.77	257	96.19	67.04
9 and 10	Superior 30 Sand	0.227	1.86	0.88	104.3	42.33
13 and 14	Iron-Modified Activated Alumina (Actiguard AAFS-50)	0.344	1.55	236	105.8	57.51
15 and 16	Granular Ferric Hydroxide	0.187	4.26	175	96.06	35.13
17 and 18	Bayoxide E33	0.320	3.34	125	0.027	77.14

As can be seen from the data in Table 3-5, the 28 x 48 mesh activated alumina has the most surface area per gram of media (288 m^2/g). The coarse mesh AA (14 x 28) has the second highest surface area of the media tested (257 m^2/g). The Fe-modified AA and the Superior 30 sand have the largest pore diameters (approximately 105 μm) followed by the coarse AA and GFH measured at 96 μm. The abnormally small measured pore diameter of the Bayoxide E33 media is possibly due to an oxide coating that limited intrusion of mercury (MAS).

Column Packing and Conditioning

During media installation, the columns were packed wet. The various valves on each column were closed and the column filled with a few inches of water. Conditioned media was placed in each column a cupful at a time, alternating cups to each replicate column. Care was taken to avoid voids and air pockets, especially around the sample ports. Columns were filled with 24 inches (61 cm) of media, the surface leveled and then capped with a 6-inch (15.2 cm) layer of Superior 30 sand. After the columns were filled, tap water was run through the columns (at the target loading rate of 20.6 mL/min) and effluent samples for turbidity were periodically collected. Columns were rinsed with tap water until the effluent turbidity was below 2 NTU. Final conditioned effluent turbidity results are summarized in Table 3-6.

3.2.3 Operation of the 4-Inch Column Filters

Steps involved in operation of the 4-inch filter columns during Phase IV were the same as described in the M&O Plan and are briefly summarized in this report. For a complete description the reader is referred to the M&O Plan.

Table 3-6. 4-Inch Filter Column Effluent Turbidity after Conditioning

4-Inch Column Number	Media	Effluent Turbidity after Conditioning (NTU)
-	Tap Water	0.05
1	Existing Activated Alumina	0.97
2	Existing Activated Alumina	0.98
3	Existing Fine Sand	0.74
4	Existing Fine Sand	0.71
5	Activated Alumina (28/48)	0.24
6	Activated Alumina (28/48)	0.29
7	Alternate Activated Alumina (14/28)	0.29
8	Alternate Activated Alumina (14/28)	0.19
9	Superior 30 Sand	1.13
10	Superior 30 Sand	1.77
11	Limestone	0.15
12	Limestone	0.24
13	Iron Modified Activated Alumina	0.15
14	Iron Modified Activated Alumina	0.14
15	Granular Ferric Hydroxide	1.70
16	Granular Ferric Hydroxide	1.20
17	Iron Oxide	0.08
18	Iron Oxide	0.08

Essentially, storm water or snowmelt runoff was collected after a rain event or warming period, and stored in the Baker tank for subsequent use. The clarifier was filled with new storm water approximately 24 hours prior to starting flow to the columns. After each run, the clarifier was cleaned with tap water. Unlike Phase III operation, there was no scheduled on/off cycling of the 4-inch filter columns. Columns remained in service until: 1) the storm water batch was used up, 2) it was desired to terminate the run due to changing quality of the water stored in the Baker tank, or 3) it was desired to start a new batch with fresh storm water. With the exception of "back-to-back" runs, the columns were drained after each run. Flow rate data and a discussion of flow control are presented in Section 5.2.2 (Chapter 5).

Upon column hydraulic failure (height of the water >42 inches over the media surface) the sacrificial sand cap was removed and replaced. If the sand cap replacement did not restore flow through the column, then the top layer of media (1 to 3 inches, typically) was removed and replaced. In some cases, more than one inch of media needed to be replaced to restore flow. Detailed documentation of overflow occurrences and column reconstruction activities performed in Phase IV are presented in Section 4.2.2.

3.2.4 Monitoring and Sampling of the 4-Inch Filter Columns

The 4-inch filter columns were monitored for hydraulic performance by recording date, time and the head of water above the filter media (sand cap) surface daily. Column flow rates were also measured and recorded daily. Filter performance was monitored by collecting: 1) column effluent samples, 2) interface water samples (from the sand cap/media interface), and 3) samples drawn from a depth of 12 inches (from the media surface). Each of the three different types of samples was collected once during each run for each column as described in the M&O Plan. Analytical suites for the samples are summarized in Table 3-7. Required analytical methods, sample holding times and reporting limits are the same as those in Table 3-2.

Table 3-7. 4-Inch Filter Column Samples and Analytical Parameters Monitored

Sample	Analytical Parameters Measured[a]
4-Inch Filter Effluent, Columns 1-6	pH, EC, Temp., Turb Al (T, D, AS), Alk-T, Phos (T&D), TKN(T&D), NO3+NO2, TSS
4-Inch Filter Effluent, Columns 7-18	pH, EC, Temp., Turb Al (T, D, AS), Fe (T&D) Alk-T, Phos (T&D), TKN(T&D), NO3+NO2, TSS
12” Depth	pH, EC, Temp., Turb Phos (T&D)
Composite Interface	pH, EC, Temp., Turb Phos (T&D)

[a] For abbreviations used, see Table 3-2.

Column effluent samples were collected approximately 36 to 48 hours (Day 2) after column loading began. Column effluent samples were collected by placing a clean sampling container directly under the appropriate column outlet. Because of the time required to collect sufficient sample volume, the container for effluent collection was placed under the outfall the night before sampling. The sample buckets were rinsed and a clean plastic liner was placed in each bucket before sample collection. After collection of a small amount of effluent, the liners were removed from the bucket and shaken to rinse the exposed surface. The rinse water was disposed of and the liners were placed back into their respective buckets. Effluent sample collection did not begin until the end of the day, to prevent overflow of the buckets during the night.

On Day 3, the effluent samples were placed in a staging area and sample processing began. During processing, interface and 12-inch depth samples were collected. The 12-inch depth samples were collected in 4-quart sampling buckets with removable plastic liners. Rinsing of these liners was similar to the effluent bucket liner rinsing described above. Once the 12-inch depth samples were collected and moved to the staging area, the interface samples were taken. The interface samples were collected in unused, disposable 16 oz. plastic cups. Three composite samples were formed from these interface samples. Composite Sample #1 consisted of interface samples from Columns 1-6, Sample #2 from Columns 7-12, and Sample #3 from Columns 13-18. The composite samples were made by pouring approximately 1/3 of each interface sample into a lined 4-quart sampling bucket and rising the liner. After rinsing the liner, the remainders of the interface samples were poured into the sampling bucket. Special care was taken to insure that equal volumes of interface samples were used in making the composite samples. This mixing of the interface samples was the same for each of the three composite samples. Once all of the composite samples were created, they were taken to the staging area for processing. The 12-inch depth samples, the composite samples and the effluent samples were all processed during Day 3.

3.3 Jar Test Experiments

The ability of chemicals to facilitate coagulation, flocculation, and sedimentation for the removal of phosphorus and turbidity was evaluated using a traditional jar test approach. Steps involved in jar testing during Phase IV were the same as described in the M&O Plan and are briefly summarized in this report. For a complete description the reader is referred to the M&O Plan.

3.3.1 Jar Test Apparatus

Jar test apparatus used included two Phipps & Bird Model PB-700™ six-paddle stirrers. These units are able to stir six beakers (each) at paddle speeds up to 300 rpm. Beakers used were clear acrylic square beakers (B-Ker2™ or equivalent). Handheld micro pipettors (Wheaton® and Eppendorf®) were used to measure chemicals. Other testing equipment included a 15-gallon mixing tank and a propeller mixer for storing and mixing the test water, and sample buckets (5-gallon and 4-quart) with liners for sample collection.

3.3.2 Jar Test Chemicals Used

Chemical coagulants used in Phase IV are listed in Table 3-8. Both PASS-C® and PAX-XL9® are aqueous polyaluminum chloride coagulants commonly used in the treatment of drinking water. Both of these chemicals were tested in Phase III also. The remaining chemicals (Jenchem 1720, Sumalchlor® 50, Superfloc® A-100 and SoilFix® IR) were added for Phase IV and were not previously tested. For simplicity, the chemicals subsequently named throughout this report appear without the registered or trademark symbols. Product literature for the chemicals used is provided in Appendix B of the M&O Plan.

Two of the new chemicals, Superfloc A-100 and SoilFix IR (PAM #1 and PAM #2), are anionic polyacrylamides (PAM). These chemicals come in crystalline form and a solution had to be made prior to use. To make the PAM stock solutions, one gram of the dry chemical was weighed out and mixed with one liter of warm tap water. Care was taken when pouring the chemical into the water to prevent the formation of “fish eyes” or losing chemical. The solution was stirred (with a stir plate and stir bar) at a high rate to completely dissolve the chemical. After 10 to 15 minutes, the rate was reduced to prevent shearing of the polymer chains and the solution was stirred at a very slow speed overnight. Detailed instructions for making the PAM solutions were presented in Appendix A of the M&O plan.

Table 3-8. Phase IV Chemical Coagulants

Trade Name	Formulation	Specific Gravity	Percent Aluminum	Maximum Approved Dose[a]	Supplier
PASS-C®	Polyaluminum Chloride	1.24	5.1-5.7	250 mg/L	Eaglebrook Chemicals 4801 Southwick Drive Matteson, IL 60443 Contact: John Crass Tel. (805) 639-3071
PAX-XL9®	Polyaluminum Chloride	1.26	5.4-5.8	266 mg/L	Kemiron Companies 3211 Clinton Parkway Lawrence, KS 66044 Contact: Brent Offerman Tel. (805) 640-6473
Jenchem 1720	Polyaluminum Chloride	1.29	5.95	200 mg/L	Jenchem, Inc. P.O. Box 30123 Walnut Creek, CA 94598 Contact: Charles Jennings Tel. (925) 274-3434
Sumalchlor® 50	Aluminum Chlorohydrate	1.34	12.1-12.7	250 mg/L	Summit Research Labs 45 River Road, Suite 300 Flemington, NJ 08822 Contact: Marc Muser Tel. (410) 356-5312
Superfloc® A-100	Polyacrylamide (PAM # 1)	Solid	0	2.5 mg/L	Cytec Industries 200 Pickett District Road New Millford, CT 06776 Contact: Steve Hurd Tel. (203) 321-2564
SoilFix® IR	Polyacrylamide (PAM # 2)	Solid	0	--	Ciba Specialty Chemicals 2301 Wilroy Road Sufflok, VA 23434 Contact: Stephen Meyers Tel. (757) 538-5225

[a] National Sanitation Foundation (NSF) maximum approved dose for drinking water treatment, mg/L on a liquid basis.

3.3.3 Jar Test Procedure

Jar test experiments were conducted on numerous batches of storm water using each of the coagulants listed in Table 3-8. In Phase IV, jar test experiments were conducted using three different conditions: “standard mixing”, “mixing sensitivity” and “temperature sensitivity”. Information on the three test conditions is presented in Table 3-9 and discussed briefly below. For each test, samples were collected for turbidity analysis after 15 minutes and 1 hour of settling. Complete jar test procedures for each of the three tests are presented in Appendix A of the M&O Plan. A single sample for total and dissolved phosphorus was collected from the “standard mixing” jar having the lowest turbidity after one hour of settling for each coagulant.

Table 3-9. Phase IV Jar-Test Experimental Conditions

Step/Condition	Jar-Test Experimental Conditions		
	Standard Mixing	Mixing Sensitivity	Temperature Sensitivity
Rapid Mix	1 min. @ 275 RPM	30 sec. @ 275 RPM	1 min. @ 275 RPM
Slow Mix	5 min. @ 15 RPM	-	5 min. @ 15 RPM
Settling	15 and 60 min. @ 0 RPM	15 and 60 min. @ 0 RPM	15 and 60 min. @ 0 RPM
Water Temperature	Ambient	Ambient	Chilled to <5 °C

Standard Mixing Jar Tests. So called "standard mixing" jar tests were conducted using the same protocols used in Phase III of the study (Caltrans, 2004). Two liters of storm water (at ambient laboratory temperature) were placed in each jar (B-Ker^2 brand square acrylic jars or similar), dosed with coagulant, rapidly mixed to disperse the chemical, slow mixed for a period of time to mature the floc and finally settled (no mixing) prior to turbidity measurements.

In the "standard mixing" experiments, a wide range of doses were used to assist in determining the low dose range, the "effective dose" range, and the excessive dose range of each chemical. On average, 18 jars per chemical (three separate runs using a six position apparatus) were needed.

Dosed storm water in the jars was tested for turbidity after 15 minutes and 1 hour of settling (all jars). Each sample was collected by slowly opening the small pinch valve on the sample port located on the front of the jar, wasting the first 10 mL of water, and then collecting a sample into a clean sampling cup. Samples for total and dissolved phosphorus were collected from the jar dosed at 100 mg/L and at the best turbidity dose (BTD) after 1 hour of settling for PASS-C, PAX-XL9, JC 1720 and Sumalchlor 50. Similarly, total and dissolved phosphorus samples were collected from the BTD jar and one with excess chemical for the two PAM products. Additionally, the pH and the actual temperature of the storm water in the jars were measured.

Mixing Sensitivity Jar Tests. The sensitivity of floc formation and settling to mixing was investigated in the "mixing sensitivity" jar tests. The mixing conditions used in the "standard mixing" jar tests were abrupt (short) from a water treatment standpoint. Actual field conditions for storm water treatment are expected to be even shorter. In the field, the mixing of a chemical coagulant with storm water runoff will likely be very limited. Therefore, it was desirable to determine how the coagulants performed with limited mixing.

The same jar test equipment previously described was used for the "mixing sensitivity" tests following the times and speeds listed in Table 3-9. Only a few selected doses were tested under this reduced mixing regime (typically 6 jars). All six chemicals listed in Table 3-8 were evaluated. Storm water used was at ambient (laboratory) temperature.

Dosed storm water in the jars was tested for turbidity after 15 minutes and 1 hour of settling (all jars tested). No samples for phosphorus analysis were collected. Actual temperature of the water in the jars was recorded.

Temperature Sensitivity Jar Tests. The sensitivity of floc formation and settling to storm water temperature was investigated in the “temperature sensitivity” jar tests. Two 5-gallon buckets of storm water were cooled to <5 °C in an ice bath. The same mixing conditions used in the “standard mixing” jar tests were used to measure temperature sensitivity (Table 3-9). Chemical doses used in the temperature sensitivity tests were the same as used in the “mixing sensitivity” tests.

Like the “mixing sensitivity” jars, the settled storm water in the temperature sensitivity jars was tested for turbidity after 15 minutes and 1 hour. No samples for phosphorus analysis were collected. Actual temperatures of the water in the jars were recorded.

3.3.4 Jar Test Sampling

A sample was collected from each jar into a disposable 16 oz. (950 mL) plastic deli cup by opening the valve on the front of the B-Ker^2 (situated approximately 8 cm off the bottom of the jar). The sample was mixed using a magnetic stirrer and stir-bar and then filtered for dissolved phosphorus. Samples were processed promptly at the 1-hour mark. Temperature measurements were made by selecting one of the jars (not sampled) and immersing the probe directly into the jar. Samples for turbidity were collected from the valve directly into a disposable cup.

3.4 Chemically-Enhanced Sedimentation Rate Experiments

Sedimentation (settling) experiments were carried out to further evaluate the effectiveness of chemical coagulation, flocculation and settling in reducing turbidity and phosphorus from storm water. In these experiments, 220-gallon tanks were filled with storm water that was dosed with coagulant and a series of samples were collected over time at two depths throughout the water column. Turbidity, total phosphorus and dissolved phosphorus were measured for the samples. The equipment and methods used in the sedimentation rate experiments are summarized below. Additional descriptions can be found in the M&O Plan.

3.4.1 Description of the Sedimentation Tanks Used

Sedimentation tanks used in the enhanced sedimentation rate experiments are as previously described (Caltrans, 2005, 2004, 2003b). Each tank is approximately 30 inches (762 mm) in diameter and 6.75 ft (2 m) tall. When the tank is filled with 220 gallons (833 L) of water, the water level is approximately 9 inches (23 cm) below the upper tank lip. The uppermost sampling port (A) was located approximately 12 inches (30.5 cm) below the water surface. The additional sample port (D) was spaced 36 inches below Port A. A Watson-Marlow™ peristaltic pump was used to inject liquid coagulant into the influent storm water flow though a 12-inch Komax™ static mixer in the feed piping to the sedimentation tank (Figure 2-2 in the M&O Plan).

A Danfoss Magflo® Model 3100 electromagnetic flow meter was used in conjunction with a Seepex™ model BN-10-6L pump to move storm water from the outside storage tanks to the sedimentation tanks inside the building. The flow rate was used to determine chemical feed rates for desired dosing.

3.4.2 Chemicals Used in the Sedimentation Experiments

Three chemicals were used in the sedimentation experiments: PAX-XL9, Jenchem 1720 and Superfloc A-100. Product and vendor information can be found in Table 3-8. In addition, one control (without chemical) sedimentation tank was filled and monitored.

3.4.3 Sedimentation Rate Experiments - Operation Overview

Prior to filling the sedimentation tanks, the chemical feed pump flow rate was calibrated to deliver the required chemical dose (best turbidity dose determined from jar test runs from the previous day). The chemical feed pump (peristaltic) and storm water supply pump (Seepex™ progressing cavity) were then engaged simultaneously. Chemical was pumped out of a graduated cylinder into the injection fitting on the static mixer. Approximately 9.5 minutes were required to fill each sedimentation tank with dosed storm water. Four tanks were filled, one at a time, with the three different chemical coagulants (PASS-C, PAX-XL9 and Superfloc A-100) and a control. After filling, the water inside the tanks was monitored for total and dissolved phosphorus and turbidity at the various sample ports for a period of 8 hours.

After the tank was filled and the chemical feed pump turned off, the final volume of coagulant was measured and recorded. These measurements were made to compare the target dose and actual dose of chemicals used. The following day, the sedimentation tanks were drained by pumping directly to one of two inside holding tanks.

3.4.4 Sedimentation Rate Experiments - Sampling Summary

Samples for turbidity and total and dissolved phosphorus were collected during the sedimentation rate experiments. Samples were collected from two sampling ports (A-top and D-bottom) at five different times during the 8-hour test (time = 0, 0.25, 0.5, 1, and 8 hours). An additional sample, for turbidity only, was collected the next day (at t = 24 hours) prior to emptying the tanks. Samples were drawn directly from the valved sampling ports on the side of the sedimentation tank into disposable 16 oz. (950 mL) plastic deli cups with lids. Samples were mixed using a magnetic stirrer and stir-bar and then filtered for dissolved phosphorus. Some replicate samples were collected. Measurements of temperature were made by collecting a separate fraction at the time of sampling. Measurements of EC and pH were made on a composite sample of the two ports for each time interval (fraction remaining in the cups after turbidity was determined).

Chapter 4

Pilot Project Experimental Runs

Chapter 4 Pilot Project Experimental Runs

In this chapter, details of storm water used and specific operations and events pertaining to the Phase IV activities are presented. Weather conditions during storm water collection and the exact make-up of the water are documented as well as the water quality of the batch used in the experimental runs. The events that occurred in each run are summarized in a series of "run summary" tables. Lastly, specific details of events that occurred in each of the three different tasks (i.e., operation of the 4-inch filter columns, jar test studies and the chemically-enhanced settling runs) are summarized in this chapter.

4.1 Pilot Project Influent Storm Water

In this section, weather conditions and the locations used for storm water/snowmelt water collection are presented. Specific details on the source, date collected, and storm water type (rain event or snowmelt) are documented. The influent storm waters for each run event are compared to typical highway storm water runoff quality reported within the Tahoe Basin.

4.1.1 Storm Water Used

Weather Summary

During the months of this study, November 2004 through May 2005, weather conditions in and around South Lake Tahoe were monitored closely by plant staff. National Weather Service stations located in South Lake Tahoe (airport) and in Meyers (fire station) were the primary source of rainfall data. Precipitation in November, December and January was approximately half of the average historical precipitation for these months. The daily average temperatures for these months were within the average historical range, with the exception of a few days per month that recorded slightly lower than average temperatures. In February 2005, close to two-thirds of the average amount of precipitation was received, mostly as snow. The precipitation measured in March, April, and May was near or above the historical average (three times the average was received in May, mostly as rain). Daily average temperature readings for these months were within the historical average range with the exception of brief warming periods recorded for each month. These warming periods accelerated snowmelt, which contributed to roadway runoff.

Water Collection

For Phase IV, the influent storm waters were collected after rainfall events or periods of snowmelt that led to significant roadway runoff. The exact collection sites used are summarized in Section 3.1.1. Summarized in Table 4-1 are the date and source of each of the storm water batches collected and used in Phase IV.

Leading up to a rain event, weather systems were closely tracked and Pilot Plant staff were often dispatched to inspect and monitor runoff. When significant runoff was occurring or had occurred, the initial turbidity of the basin was checked and if the volume was sufficient, the water was collected. An effort was made to collect storm water during active runoff. After the water was collected, field measurements (turbidity, EC, pH and temperature) were made and documented. In addition to these measurements, a brief description of the water source, the volume collected, the event type (rain or snowmelt) contributing to the runoff, and weather conditions (temperature and precipitation) were included in the run summary tables for each run event (Section 4.2.1).

Table 4-1. Phase IV Experimental Run Number, Date Collected and Water Source

Run	Date	Source
17A	11/12/2004	4,500 gallons from the on-site retention basin (Rain Event)
18	12/09/2004	2,250 gallons from the HY-89 basin + 2,250 gal from the Ski Run basin (Rain Event)
19	12/09/2004	4,000 gallons from the on-site retention basin (Rain Event)
20	3/10/2005	4,500 gallons from the on-site retention basin (Snowmelt)
21	3/19/2005	1,800 gallons from the HY-89 basin + 1,800 gallons from the Al Tahoe Jensen Box + 900 gallons from the Ski Run basin (Rain Event)
22	4/21/2005	4,500 gallons from the on-site retention basin (Snowmelt)
23	4/27/2005	4,500 gallons from the HY-89 basin (Rain Event)
24	5/13/2005	3,500 gallons from the on-site retention basin (Rain Event and Snowmelt)

To supply enough storm water for six to eight days of testing (4-inch columns, jar tests and sedimentation experiments), a 4,500-gallon Baker Tank was filled. On some occasions, the volumes at the collection sites, with the exception of the Ski Run basin, were inadequate to meet the 4,500-gallon requirement. When one basin (i.e., HY-89) could not supply enough storm water to fill the Baker Tank, additional water from other basins was collected (Runs 18 and 21).

4.1.2 Storm Water Quality

Water quality results for the storm water collected along with “typical” Lake Tahoe storm water runoff concentrations are listed in Table 4-2. The “typical” Lake Tahoe Basin storm water data listed were obtained from the *Caltrans Tahoe Highway Runoff Characterization and Sand Trap Effectiveness Studies, 2000-03 Monitoring Season* report (Caltrans, 2003c). These runoff samples were collected during storm events using automatic, flow-proportional samplers at six different sites located around the lake. Minimum, maximum and mean values listed in Table 4-2 are the low, high and mean of “event mean concentration” (EMC) values; whereas the influent values listed for this project are not EMC values but single sample determinations.

Table 4-2. Water Quality Summary of the Influent Storm Water Used in Phase IV Project Activities

Parameter	Units	Typical Lake Tahoe Basin Water Quality[a]			PIV Pilot Project Influent Water Quality										
		Min	Max	Mean	Min	Max	Mean[b]	Run 17A	Run 18	Run 19	Run 20	Run 21	Run 22	Run 23	Run 24
Sample	-	-	-	-	-	-	-	Baker	Baker	Baker	Baker	Baker	Baker	Baker	Baker
Influent Collected	(date)	-	-	-	-	-	-	11/12/04	12/9/04	12/9/04	3/11/05	3/19/05	4/22/05	4/28/05	5/13/05
Date Sampled	(date)	-	-	-	-	-	-	11/13/04	12/10/04	12/17/04	3/12/05	3/19/05	4/23/05	4/30/05	5/15/05
Event Type	-	-	-	-	-	-	-	Rain	Rain	Rain	Snowmelt	Rain	Snowmelt	Rain	Rain/Melt
Source	-	-	-	-	-	-	-	On-Site	HY-89+Ski Run	On-Site	On-Site	HY-89+Al Tahoe+Ski Run	On-Site	HY-89	On-Site
pH (field)	S.U.	5.6	9.6	7.2	7.2	8.08	7.4[c]	7.2	7.2	7.4	7.3	7.4	7.5	7.4	8.1
EC (field)	µS	25	21,000	2,382	440	4,844	2,131	4,844	2,037	1,900	3,022	636	3,616	556	440
Turbidity (average, field)	NTU	8	2,620	477	190	1,764	535	190	191	841	1,764	256	408	316	429
Temperature (field)	^{0}C	*NA*	*NA*	*NA*	5.5	13.8	9.075	6.5	5.5	9.5	7.1	6.3	13.3	10.6	13.8
Acid Soluble Aluminum[d]	µg/L	*NA*	*NA*	*NA*	109	1,160	395	690	347	1,160	322	109	200	147	184
Aluminum - total	µg/L	*NA*	*NA*	*NA*	2,792	18,370	7,099	2,792	3,496	8,350	18,370	4,693	6,648	6,161	6,279
Iron - total	µg/L	1,180	162,000	17,723	4,820	34,600	11,645	4,820	5,550	15,700	34,600	6,030	8,940	8,840	8,680
Aluminum - dissolved	µg/L	*NA*	*NA*	*NA*	< 25	28	< 25	< 25	< 25	< 25	< 25	< 25	< 25	28	< 25
Iron - dissolved	µg/L	*NA*	*NA*	451	< 25	172	69	25	87	< 25	37	157	49	172	< 25
Alkalinity - total	mg-$CaCO_3$/L	*NA*	*NA*	*NA*	20	56	33	26	24	38	40	34	28	56	20
Phosphorus - dissolved	mg-P/L	*NA*	*NA*	0.07	< 0.03	0.33	0.10	< 0.03	0.05	< 0.03	0.08	0.03	0.08	0.20	0.33
Kjeldahl Nitrogen - total	mg-N/L	0.20	19.0	2.40	0.27	2.11	1.10	0.39	1.90	1.75	2.11	0.27	0.96	0.57	0.85
Kjeldahl Nitrogen - dissolved	mg-N/L	*NA*	*NA*	*NA*	< 0.10	1.06	0.28	0.19	1.06	< 0.10	< 0.10	0.17	< 0.10	0.52	0.16
Total Organic Carbon	mg/L	3.0	55.0	32.0	3.7	20.4	9.4	9.5	20.4	7.7	5.4	18.5	5.5	4.5	3.7
Phosphorus - total	mg-P/L	0.04	19.0	2.14	0.12	1.24	0.53	0.12	0.13	0.51	1.24	0.47	0.61	0.48	0.64
Total Suspended Solids	mg/L	22	5,800	759	112	906	371	112	144	588	906	262	261	377	321
Volatile Suspended Solids	mg/L	*NA*	*NA*	*NA*	31	711	154	31	50	56	711	201	52	71	58
Nitrate + Nitrite	mg-N/L	< 0.10	2.70	0.30	< 0.10	0.24	< 0.10	0.24	0.20	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Nitrogen (calculated)	mg-N/L	0.20	21.7	2.70	0.27	2.11	1.16	0.63	2.10	1.75	2.11	0.27	0.96	0.57	0.85

Notes:

a Data from Caltrans Tahoe Highway Runoff Characterization and Sand Trap Effectiveness Studies, 2000-03 Monitoring Season, CSTW-RT-03-054.36.02
b Mean of influent samples. Means calculated using ½ of reporting limit value for concentrations below reporting limit.
c Mean for pH calculated by averaging the molar concentration of the hydrogen ions.
d Acid soluble aluminum by EPA method 440/5-86-008 (unfiltered sample collected in the field, acidified and filtered in the laboratory).
NA Not Available (statistics not reported in publication cited).

The parameters with established numerical discharge limits in the Tahoe Basin (i.e., turbidity, total nitrogen, total phosphorus, total iron and oil and grease, see Table 2-1) are generally present in roadway runoff in concentrations in excess of those limits. The constituents present in the storm water collected and utilized during Phase IV were generally present at concentrations lower than those reported to be typical of Tahoe Basin highway storm water runoff; however, they generally exceeded the limits established by the LRWQCB for surface water discharge. Of particular note:

- The mean concentration of total Kjeldahl nitrogen (TKN) in the pilot project influent was approximately half of the mean EMC TKN concentration.
- As observed in previous phases, the average concentration of total phosphorus in the Pilot Plant storm water was 0.53 mg-P/L, which was appreciably lower than "typical" Tahoe storm water runoff (EMC = 2.14 mg-P/L). As described below, small amounts of soluble phosphorus was added to the storm water in several of the experimental runs. As a result, the average dissolved phosphorus on the Pilot Plant influent water was 0.10 mg-P/L, which is slightly above the "typical" level of 0.07 mg-P/L.
- The average turbidity of the Phase IV storm waters (n = 8) was 535 NTU, which is slightly above the EMC of 477 NTU.
- Total aluminum was present in the storm water collected at an average of 7,099 µg/L while levels of dissolved aluminum were generally below detection limit (25 µg/L). Aluminum was not monitored in the *Caltrans Tahoe Highway Characterization Study* (Caltrans, 2003c), therefore, there is no "typical" concentration to reference.

It is expected that the concentrations of constituents that may potentially settle (i.e., particulate solids, TSS, total metals, and turbidity to some extent) will be lower in the storm water collected for this investigation than in rain event end-of-pavement samples. This is because the storm water for this study was collected from ponds and basins where some sedimentation had already occurred.

Jar Tests and Sedimentation Experiments

Because the 4-inch media columns were not ready in early November when the first storm hit, only the jar test and sedimentation experiments were conducted during Run 17A. The jar test and sedimentation runs were completed in Experimental Runs 17A through 23 (Table 4-2).

Phosphorus Addition

Phosphorus was added to bulk storm water in the Baker Tank during Experimental Runs 20, 22, 23 and 24, using the procedure outlined in Section 3.1.4. Storm water collected in Experimental Run 21 (rain event runoff collected from the HY-89 basin, Ski Run and the Jensen Box at Al Tahoe) had a slight color that interfered with the colorimetric endpoint of the field test kit. As a result, the presence of sufficient dissolved phosphorus was indicated and no phosphorus was added to the storage tank in Run 21.

4.2 Experimental Run Summaries

In this section, details of the operation of the 4-inch extended run filter columns, the sedimentation experiments and jar tests are presented. Storm water source, date of run and sequence of operations are documented. Also included in this section are the Experimental Run Summary tables generated after each run event (Runs 17A - 24). Additional information and details relating to the performance of the various systems and experiments (such as net flow rate and loading, filter blinding, determination of chemical dose, etc.) are presented in the results chapter (Chapter 5).

4.2.1 Tabular Run Summaries

After completion of each run event, a summary table was created to summarize the systems operated, problems, observations and preliminary results. Because these provide a concise summary of the run activities, they are included in this section. Summary tables from run events 17A – 24 are presented in the subsequent pages after a brief introductory description of issues relating to each run. Each run summary table includes information on head, turbidity, and phosphorus levels in the effluents of each 4-inch filter column and any rebuilding/reconstruction activity. For the jar tests, the tables indicate the most effective dose, and the 15 and 60 minute turbidity values for each of the mixing regimes. Also included in the tables are the 8-hour turbidity values (from port A and D) of each of the sedimentation experiments. Additional discussions of the results are included in the following chapter.

Run 17A. The storm water for this run resulted from a rain event and was collected from the on-site basin. During this run, the 4-inch filter columns were not active because not all of the filter media had been received or pretreated prior to the start of this run. Jar tests and sedimentation experiments were conducted as outlined in the M&O Plan.

Run 18. This run event's storm water originated from a rain event and was collected from the HY-89 basin and Ski Run basin (2,250 gallons from each basin). The 4-inch filter columns were initiated during this run. The jar tests were completed according to the M&O Plan with a slight modification. The influent storm water was below 5^0C; therefore, no "temperature sensitivity" jars were tested. Sedimentation experiments were conducted as normal.

Run 19. Storm water for Run 19 was collected at the same time as the Run 18 water. The storm water was collected from the on-site basin after a rain event. Filter columns, jar tests, and sedimentation experiments were conducted as normal. This run event was terminated before completion due to ice buildup in the Baker Tank; therefore, the 4-inch filter columns were only in operation for four full days.

Run 20. Snowmelt runoff from the on-site basin was the water source for this run. The turbidity of the influent water was quite high (1,764 NTU). This run was the first run in which the storm water was spiked with dissolved phosphorus. The 4-inch filter columns were operated as normal, and an additional "mini column" of limestone (12" of media only) was placed under the outfall port of Column 6 (containing the 28x48 activated alumina, see Section 3.2.1). Jar tests were completed as outlined in the M&O Plan, with the exception that the influent water was below 5°C and no "temperature sensitivity" tests were performed. Sedimentation experiments were conducted as usual.

Run 21. Storm water for this run was collected after a rain event from three different basins: HY-89, Al Tahoe Jensen Box and Ski Run basin. Proportions of storm water collected from each basin are listed in Table 4-1. Influent water was tested onsite for dissolved phosphorus, which was thought to be sufficiently present (>0.07 mg-P/L), and therefore no phosphorus was added. The 4-inch filter columns, jar tests and sedimentation experiments were operated as usual, except, as in Experimental Run 20, the influent water was cold enough to omit the "temperature sensitivity" jar tests.

Run 22. Snowmelt water was collected from the on-site basin for use in Run 22. The dissolved phosphorus concentration of the influent was measured and the influent water was then "spiked" with additional phosphorus. The 4-inch filter columns, jar tests, and sedimentation experiments were operated as usual.

Run 23. Influent storm water was collected after a rain event from the HY-89 basin. After field analysis, the water was "spiked" with sodium phosphate to increase the level of phosphorus. Due to excessive head loss, before starting the run, 12 inches of media were removed from Columns 13 and 14 (Fe-modified AA, see Section 5.2.2) From this point on, Columns 13 and 14 were operated as 12-inch deep media filters. Jar tests and sedimentation experiments were completed as usual.

Run 24. Water used in Experimental Run 24 was a combination of rain runoff from a few days earlier and snowmelt water from the day of collection. Storm water was collected from the on-site basin and supplemented with phosphorus. Columns 13 and 14 continued to operate with 12 inches of media, and the rest of the columns were operated as usual. No jar tests or sedimentation experiments were completed during this event.

Experimental Run Summary - Run # 17A

Run Number	17A
Date Run	November 12 - 16, 2004
Water Source	Storm water used for Run 17A was collected at 2 pm on 11/12/04 from the on-site basin by pilot plant personnel. Mix proportion: 100% On-Site Detention Basin (approximately 4,500 gallons).
Weather	Climate station in South Lake Tahoe (airport) recorded 0.11 inches of rain on Wednesday November 10^{th} and 0.07 inches on Thursday the 11^{th}. Climate station in Meyers recorded 0.14 inches on the 10^{th} and 0.22 inches on the 11^{th}. Daytime high temperatures during this period ranged from 50 to 54 ºF while the nightly low temperatures ranged from 26 to 33 ºF.
Storm Water Quality Characteristics	pH = 7.2 EC = 4844 µS Phos-T = 0.12 mg-P/L, Phos-D = < 0.03 mg-P/L Turbidity = 190 NTU Average Temperature = 6.5 °C
Laboratory	Pat-Chem

Operational Notes and Summary

4-Inch Columns **Operational Notes**

Filter columns were not run

Column #	Media	Notes and Observations
1	AA (8x48 DD-2) (existing)	Unchanged
2	AA (28x48 DD-2) (existing)	Unchanged
3	Fine Sand (existing)	Unchanged
4	Fine Sand (existing)	Unchanged
5	AA (28x48 DD-2) (new)	Installed (pre-rinsed) media 11/10/04, effluent turb = 0.24 NTU
6	AA (28x48 DD-2) (new)	Installed (pre-rinsed) media 11/10/04, effluent turb = 0.29 NTU
7	AA (14x28 DD-2) (new)	Installed (pre-rinsed) media 11/10/04, effluent turb = 0.29 NTU
8	AA (14x28 DD-2) (new)	Installed (pre-rinsed) media 11/10/04, effluent turb = 0.19 NTU
9	Superior 30 Sand (new)	Installed (pre-rinsed) media 11/10/04, effluent turb = 1.1 NTU
10	Superior 30 Sand (new)	Installed (pre-rinsed) media 11/10/04, effluent turb = 1.8 NTU
11	Limestone (new)	Installed (pre-rinsed) media 11/10/04, effluent turb = 0.15 NTU
12	Limestone (new)	Installed (pre-rinsed) media 11/10/04, effluent turb = 0.24 NTU
13	Fe-Mod AA (AA-FS50, 28x48) (new)	Rinsed, yet to be installed
14	Fe-Mod AA (AA-FS50, 28x48) (new)	Rinsed, yet to be installed
15	GFH (size 0.2-0.3 mm) (new)	Installed (pre-rinsed) media 11/15/04, not flowing, to be rebuilt
16	GFH (size 0.2-0.3 mm) (new)	Installed (pre-rinsed) media 11/15/04, not flowing, to be rebuilt
17	Fe-Oxide (Bayoxide E33) (new)	Installed (pre-rinsed) media 11/12/04, effluent turb = 0.08 NTU
18	Fe-Oxide (Bayoxide E33) (new)	Installed (pre-rinsed) media 11/12/04, effluent turb = 0.08 NTU
19	Open	
20	Open	

Jar Test Experiments (Run 17 A)

Chemical

PAX-XL9

Date Run: 11/13/04, 14:00 – 15:45
Number of Jars: 36
Dose Range Tested: 0 – 250 mg/L **BTD =** 70 mg/L (product)
Temperature Range: 7.5 - 8.8 **pH Range** = 5.9 – 7.0
Notes: Good floc observed

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	70	17.4	70	10.9
Mixing Sensitivity	75	78.4	75	41.5
Temp Sensitivity (3.3 ºC)	75	22.9	50	14.7

PASS-C

Date Run: 11/14/04, 14:45 – 15:30
Number of Jars: 36
Dose Range Tested: 0 – 400 mg/L **BTD =** 50 mg/L (product)
Temperature Range: 7.2 – 9.0 **pH Range** = 5.3 – 7.0
Notes: Good floc observed

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	50	22.3	50	8.9
Mixing Sensitivity	110	86.1	110	38.5
Temp Sensitivity (4.0 ºC)	80	20.9	50	12.5

Sumalchlor 50

Date Run: 11/14/04, 11:30 – 13:40
Number of Jars: 35
Dose Range Tested: 0 – 400 mg/L **BTD =** 25 mg/L (product)
Temperature Range: 5.5 – 9.2 **pH Range** = 6.4 – 7.3
Notes: Only pin floc observed in lower doses

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	25	71.9	25	32.2
Mixing Sensitivity	10	157	10	113
Temp Sensitivity (3.3 ºC)	10	105	10	44.3

Jar Test Experiments, Continued (Run 17A)

Chemical

JC1720

Date Run: 11/13/04, 9:20 – 11:20
Number of Jars: 33
Dose Range Tested: 0 – 400 mg/L **BTD =** 120 mg/L (product)
Temperature Range: 7.8 - 8.5 **pH Range** = 5.3 – 7.2
Notes: Nice, good settling floc observed

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	120	12.5	120	10.2
Mixing Sensitivity	125	34.3	125	15.5
Temp Sensitivity (2.6 ºC)	100	19.1	100	12.9

PAM #1
(Cytec A100)

Date Run: 11/13/04, 18:00 – 20:00
Number of Jars: 32
Dose Range Tested: 0 – 4.0 mg/L **BTD =** 1.20 mg/L (product)
Temperature Range: 8.2 – 10.0 **pH Range** = 7.1 – 7.2
Notes: Large, slow settling, dense, dark floc observed

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	1.20	18.6	1.2	15.0
Mixing Sensitivity	1.00	37.0	1.0	21.0
Temp Sensitivity (3.0 ºC)	1.50	20.1	1.5	15.2

PAM #2
(Ciba Soilfix IR)

Date Run: 11/14/04, 8:30 – 10:30
Number of Jars: 36
Dose Range Tested: 0 – 4.0 mg/L **BTD =** 0.80 mg/L (product)
Temperature Range: 5.5 – 8.1 **pH Range** = 7.2 – 7.3
Notes: Fine to med. floc observed, cloudy solution

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	0.80	34.7	0.80	28.3
Mixing Sensitivity	0.50	67.8	1.25	42.4
Temp Sensitivity (4.3 ºC)	0.75	34.4	1.00	25.7

Settling Test Experiments (Run 17A)

Chemical

PAX-XL9

Date Run:	11/15/04	**Time Started:**	8:00
Target Dose:	70 mg/L	**Actual Dose:**	70 mg/L
Temp Range (ºC):	6.5 – 9.8	**pH:**	6.8

	Port A (top)	Port D (lower)
Turbidity measured after 8 hours	10.6 NTU	12.1 NTU
Estimated settling time required to 20 NTU	6.4 hrs	6.7 hrs

JC1720

Date Run:	11/15/04	**Time Started:**	8:15
Target Dose:	120 mg/L	**Actual Dose:**	120 mg/L
Temp Range (ºC):	6.5 – 10.0	**pH:**	6.8

	Port A (top)	Port D (lower)
Turbidity measured after 8 hours	8.7 NTU	10.1 NTU
Estimated settling time required to 20 NTU	6.4 hrs	6.6 hrs

PAM #1 (Cytec A100)

Date Run:	11/15/04	**Time Started:**	8:45
Target Dose:	1.2 mg/L	**Actual Dose:**	1.2 mg/L
Temp Range (ºC):	6.5 – 11.0	**pH:**	7.1

	Port A (top)	Port D (lower)
Turbidity measured after 8 hours	49.8 NTU	54.9 NTU
Estimated settling time required to 20 NTU	31.4 hrs	36.4 hrs

Control

Date Run:	11/15/04	**Time Started:**	9:05
Target Dose:	none	**Actual Dose:**	none
Temp Range (ºC):	6.5 – 11.0	**pH:**	7.2

	Port A (top)	Port D (lower)
Turbidity measured after 8 hours	156 NTU	158 NTU
Estimated settling time required to 20 NTU	86 hrs	229 hrs

Experimental Run Summary - Run # 18

Run Number	18
Date Run	December 10-19, 2004
Water Source	Storm water used for Run 18 was collected from 12:00-4:00 PM on 12/9/04 from the HWY 89 Basin and the Ski Run Basin. Mix proportion: 50% HWY 89 Basin (approximately 2,250 gallons) 50% Ski Run Basin (approximately 2,250 gallons)
Weather	Climate station in South Lake Tahoe (airport) recorded 0.29 inches of rain on Tuesday December 7th, 2004, and 0.42 inches on Wednesday the 8th. Climate station in Meyers recorded 0.81 inches on the 7th and 1.16 inches on the 8th. Daytime high temperatures during this period ranged from 35 to 40 ºF while the nightly low temperatures ranged from 31 to 32 ºF.
Storm Water Quality Characteristics	pH = 7.2 EC = 2037 µS Phos-T = 0.13 mg-P/L, Phos-D = 0.05 mg-P/L Turbidity = 191 NTU Temperature = 5.5 °C
Laboratory	Pat-Chem

Operational Notes and Summary

4-Inch Columns	**Operational Notes**
	During Run 18, all columns were run continuously from 8:20 AM Saturday 12/11/04 to 8:15 AM Sunday 12/19/04 (8 days, 96 ft). Upon hydraulic failure (head > 42" above media) the filter was "rebuilt" by replacing the protective sand cap with new, washed Superior 30 sand. No columns required removal of the upper few inches of media to restore flow. Clarifier started on 12/9/04. Effluent turbidity measured daily. Samples for chemical analysis collected on 12/13/04 (2 days into operation). Turbidity at the sand/media interface and 12-inch depth measured once (12/13/04) during the run.
Clarifier	Effluent Turbidity (NTU) - 106 (85.1 – 125) Effluent Phos (mg/L) - Phos-T = 0.10 mg-P/L, Phos-D = < 0.03 mg-P/L
Columns 1 & 2	Existing Activated Alumina (28/48 mesh DD-2) Filters Rebuilt - Both filters rebuilt once (Day 5) Head - 28-42", 15" after reconstruction, 32" at end of run Effluent Turbidity (NTU) - 0.80 (0.2 – 1.0) Effluent Phos-T (mg/L) - <0.03
Columns 3 & 4	Existing Fine Sand (Lapis F-105) Filters Rebuilt - #3 not rebuilt, #4 Rebuilt on Day 6 Head - Start at 6" and rise to 38-42" Effluent Turbidity (NTU) - 11.0 (1.7– 41.2) Effluent Phos-T (mg/L) - <0.03
Columns 5 & 6	Activated Alumina (28/48 mesh DD-2) Filters Rebuilt - #5 rebuilt on Day 8, #6 not rebuilt (will be on Day 1, Run 19) Head - 8-42" Effluent Turbidity (NTU) - 0.20 (0.1 – 0.4) Effluent Phos-T (mg/L) - <0.03

4-Inch Columns	**Run 18 Operational Notes – Continued**	
Columns 7 & 8	Activated Alumina (14/28 mesh DD-2)	
	Filters Rebuilt -	#7 rebuilt on Day 8, #9 not rebuilt
	Head -	7-42”
	Effluent Turbidity (NTU) -	0.95 (0.2-1.7)
	Effluent Phos-T (mg/L) -	<0.03
Columns 9 & 10	Superior 30 Sand	
	Filters Rebuilt -	Both filters rebuilt on Day 6
	Head -	8-42”, 8” after reconstruction, filters end at 13”
	Effluent Turbidity (NTU) -	12.3 (2.7-28.1)
	Effluent Phos-T (mg/L) -	<0.03
Columns 11 & 12	Limestone (Teichert #4 Limestone Sand)	
	Filters Rebuilt -	Both filters rebuilt on Day 8
	Head -	4-42”
	Effluent Turbidity (NTU) -	12.6 (2.7-34.2)
	Effluent Phos-T (mg/L) -	<0.03
Columns 13 & 14	Iron Modified Activated Alumina (Alcan)	
	Filters Rebuilt -	#13 not rebuilt, #14 rebuilt on Day 7
	Head Range -	7-42”
	Effluent Turbidity (NTU) -	0.17 (0.1-0.4)
	Effluent Phos-T (mg/L) -	<0.03
Columns 15 & 16	Granular Ferric Hydroxide (U.S. Filter)	
	Filters Rebuilt -	Both filters rebuilt on Day 5
	Head -	7-42”, 7” after reconstruction, filters end at 19”
	Effluent Turbidity (NTU) -	1.90 (0.2-4.4)
	Effluent Phos-T (mg/L) -	<0.03
Columns 17 & 18	Iron Oxide (Bayoxide E33, Severn Trent)	
	Filters Rebuilt -	#17 not rebuilt, #18 rebuilt on Day 8
	Head -	5-42”
	Effluent Turbidity (NTU) -	2.38 (0.2-4.8)
	Effluent Phos-T (mg/L) -	<0.03

Jar Test Experiments **Run 18, Cont.**

Note: Since influent storm water temperature was between (4-7°C), no "Temperature Sensitivity" (cold) jars were run; however, a bucket of water was warmed in a water bath and several tests were made with warm water (26-30°C).

Chemical

PAX-XL9

Date Run: 12/11/04, 16:00-19:00
Number of Jars: 49
Dose Range Tested: 0 – 400 mg/L **BTD =** 100 mg/L (product)
Temperature Range: 6.3-7.4°C **pH Range** = 6.7-7.1
Notes: Good floc observed

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	100	13.3	100	8.25
Mixing Sensitivity	75	67.7	75	27.2
Temp Sensitivity, 26.5ºC	50	9.07	50	3.5

PASS-C

Date Run: 12/10/04, 13:00–15:00
Number of Jars: 40
Dose Range Tested: 0 – 400 mg/L **BTD =** 100 mg/L (product)
Temperature Range: 5.7-7.4 **pH Range** = 5.3 – 7.0
Notes: Good floc observed

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	100	11.7	100	8.2
Mixing Sensitivity	100	65.6	100	35.2
Temp Sensitivity, 30ºC	125	5.0	125	2.3

Sumalchlor 50

Date Run: 12/10/04, 09:00 – 12:00
Number of Jars: 38
Dose Range Tested: 0 – 400 mg/L **BTD =** 35 mg/L (product)
Temperature Range: 4.4 – 7.2 **pH Range** = 6.1 – 7.2
Notes: Only small floc observed in lower doses

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	35	47.1	35	19.8
Mixing Sensitivity	30	178	35	74.8
Temp Sensitivity, 30 ºC	40	10.3	40	4.3

Jar Test Experiments **Run 18, Cont.**

Chemical

JC1720

Date Run: 12/10/04, 16:00 – 18:00
Number of Jars: 48
Dose Range Tested: 0 – 400 mg/L **BTD =** 80 mg/L (product)
Temperature Range: 6.1-8.1 **pH Range** = 6.2-7.1
Notes: Nice, good settling floc observed

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	80	15.3	80	8.7
Mixing Sensitivity	80	90.2	70	34.8
Temp Sensitivity, 30 ºC	150	1.73	50	3.2

PAM #1
(Cytec A100)

Date Run: 12/11/04, 12:00 – 18:00
Number of Jars: 48
Dose Range Tested: 0 – 4.0 mg/L **BTD =** 0.5 mg/L (product)
Temperature Range: 5.9-7.0 **pH Range** = 7.2
Notes: Large, slow settling, dense, dark floc observed

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	0.50	35.7	0.50	32.2
Mixing Sensitivity	0.50	60.7	0.50	42.0
Temp Sensitivity, 26.5ºC	0.50	24.0	0.50	20.7

PAM #2
(Ciba Soilfix IR)

Date Run: 12/11/04, 8:00 – 12:00
Number of Jars: 32
Dose Range Tested: 0 – 3.0 mg/L **BTD =** 0.20 mg/L (product)
Temperature Range: 6.0-7.7 **pH Range** = 7.3
Notes: Fine to med. floc observed, cloudy solution

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	0.10	63.3	0.20	55.2
Mixing Sensitivity	0.35	112	0.35	96.7
Temp Sensitivity, 26.5ºC	0.20	48.3	0.20	38.9

Settling Test Experiments **Run 18**

Chemical

PAX-XL9

Date Run:	12/12/04	**Time Started:**	10:00
Target Dose:	100 mg/L	**Actual Dose:**	100 mg/L
Temp Range (ºC):	7.3 – 9.4	**pH:**	6.7

	Port A (top)	Port D (lower)
Turbidity measured after 8 hours	9.2 NTU	11.5 NTU
Estimated settling time required to 20 NTU	5.8 hrs	6.3 hrs

JC1720

Date Run:	12/12/04	**Time Started:**	10:25
Target Dose:	80 mg/L	**Actual Dose:**	80 mg/L
Temp Range (ºC):	7.2 – 9.8	**pH:**	6.8

	Port A (top)	Port D (lower)
Turbidity measured after 8 hours	7.9 NTU	12.3 NTU
Estimated settling time required to 20 NTU	6.1 hrs	6.8 hrs

PAM #1 (Cytec A100)

Date Run:	12/12/04	**Time Started:**	08:45
Target Dose:	0.50 mg/L	**Actual Dose:**	0.52 mg/L
Temp Range (ºC):	7.2 – 8.9	**pH:**	7.1

	Port A (top)	Port D (lower)
Turbidity measured after 8 hours	96.2 NTU	106 NTU
Estimated settling time required to 20 NTU	37 hrs	44 hrs

Control

Date Run:	12/12/04	**Time Started:**	10:55
Target Dose:	None	**Actual Dose:**	None
Temp Range (ºC):	7.2 – 9.4	**pH:**	7.1

	Port A (top)	Port D (lower)
Turbidity measured after 8 hours	158 NTU	164 NTU
Estimated settling time required to 20 NTU	45 hrs	63 hrs

Experimental Run Summary - Run # 19

Run Number	19
Date Run	December 19-23, 2004
Water Source	Storm water used for Run 19 was collected from 3:30 to 6:00 PM on 12/9/04 from the on-site detention basin adjacent to the pilot facility. Mix proportion: 100% on-site basin water (approximately 4,000 gallons)
Weather	Climate station in South Lake Tahoe (airport) recorded 0.29 inches of rain on Tuesday December 7th, 2004, and 0.42 inches on Wednesday the 8th. Climate station in Meyers recorded 0.81 inches on the 7th and 1.16 inches on the 8th. Daytime high temperatures during this period ranged from 35 to 40 ºF while the nightly low temperatures ranged from 31 to 32 ºF.
Storm Water Quality Characteristics	pH = 7.4 (on-site measurements) EC = 1,900 µS Phos-T = 0.51 mg-P/L, Phos-D = < 0.03 mg-P/L Turbidity = 841 NTU Temperature = 9.5 °C
Laboratory	Pat-Chem

Operational Notes and Summary

4-Inch Columns — **Operational Notes**

During Run 19, all columns were run continuously from 12:00 Noon Sunday 12/19/04 to 1:30 PM Thursday 12/23/04 (4 days, 48 ft). Upon hydraulic failure (head > 42" above media) a filter was removed from service and "rebuilt" by replacing the protective sand cap with new, washed Superior 30 sand. As with Run 18, no columns required "reconstruction" (i.e. the removal of the upper few inches of media to restore flow). A new clarifier was constructed on Friday 12/17/04 and charged and equilibrated until use on 12/19/04.

Filter effluent turbidity was measured daily. Samples for chemical analysis were collected on 12/21/04 (2 days into operation). Turbidity at the sand/media interface and 12-inch depth measured once (12/21/04) during the run.

Clarifier	Effluent Turbidity (NTU) -	591 (565 – 612)
	Effluent Phos-T (mg/L) -	Phos-T = 0.24 mg-P/L, Phos-D = < 0.03 mg-P/L
Columns 1 & 2	Existing Activated Alumina (28/48 mesh DD-2)	
	Filters Rebuilt -	Both filters rebuilt once (Day 1)
	Head -	17-42", 18" after reconstruction, 30" at end of run
	Effluent Turbidity (NTU) -	19.2 (2.3-31.9)
	Effluent Phos-T (mg/L) -	<0.03
Columns 3 & 4	Existing Fine Sand (Lapis F-105)	
	Filters Rebuilt -	#3 rebuilt once (Day 1), #4 Rebuilt on Day 2
	Head -	7 to 42", end run at 7"
	Effluent Turbidity (NTU) -	124 (85-159)
	Effluent Phos-T (mg/L) -	0.04
Columns 5 & 6	Activated Alumina (28/48 mesh DD-2)	
	Filters Rebuilt -	#5 rebuilt prior to start, #6 rebuilt on Day 1
	Head -	8-12" after reconstruction, end run near 13"
	Effluent Turbidity (NTU) -	17.3 (0.2-33.5)
	Effluent Phos-T (mg/L) -	<0.03

4-Inch Columns	**Run 19 Operational Notes – Continued**	
Columns 7 & 8	Activated Alumina (14/28 mesh DD-2)	
	Filters Rebuilt -	#7 rebuilt prior to start, #8 rebuilt on Day 2
	Head -	8-14” after reconstruction
	Effluent Turbidity (NTU) -	99.8 (57.9-129)
	Effluent Phos-T (mg/L) -	0.03
Columns 9 & 10	Superior 30 Sand	
	Filters Rebuilt -	Not rebuild (serviced 3 day prior, in Run 18)
	Head -	10-30”
	Effluent Turbidity (NTU) -	149 (110-194)
	Effluent Phos-T (mg/L) -	0.10
Columns 11 & 12	Limestone (Teichert #4 Limestone Sand)	
	Filters Rebuilt -	Both filters rebuilt prior to run
	Head -	6-12”
	Effluent Turbidity (NTU) -	163 (114-213)
	Effluent Phos-T (mg/L) -	0.06
Columns 13 & 14	Iron Modified Activated Alumina (Alcan)	
	Filters Rebuilt -	#13 rebuilt on Day 1, #14 rebuilt 2 day earlier (Run 18)
	Head -	8-18”
	Effluent Turbidity (NTU) -	0.92 (0.22-2.4)
	Effluent Phos-T (mg/L) -	<0.03
Columns 15 & 16	Granular Ferric Hydroxide (U.S. Filter)	
	Filters Rebuilt -	Both filters rebuilt on Day 2
	Head -	12-30” after service
	Effluent Turbidity (NTU) -	2.5 (1.3-3.9)
	Effluent Phos-T (mg/L) -	<0.03
Columns 17 & 18	Iron Oxide (Bayoxide E33, Severn Trent)	
	Filters Rebuilt -	#17 rebuilt on Day 1, #18 rebuilt prior to start
	Head -	8-15” after service
	Effluent Turbidity (NTU) -	94.4 (81.5-110)
	Effluent Phos-T (mg/L) -	0.03

Jar Test Experiments **Run 19, Cont.**

Note: "Temperature Sensitivity" (cold) jars were run as described in the M&O Plan
Additional experiments using gypsum not presented here.

Chemical

PAX-XL9

Date Run: 12/18/04, 12:00-14:00
Number of Jars: 32
Dose Range Tested: 0 – 400 mg/L **BTD** = 100 mg/L (product)
Temperature Range: 9.8-11.1°C **pH** = 6.3 – 7.4
Notes: Good floc observed

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	50	30.0	100	10.3
Mixing Sensitivity	100	56.5	100	26.1
Temp Sensitivity, 6.2 ºC	75	27.2	50	19.0

PASS-C

Date Run: 12/16/04, 14:45–18:00
Number of Jars: 40
Dose Range Tested: 0 – 400 mg/L **BTD =** 100 mg/L (product)
Temperature Range: 9.3-11.1 °C **pH Range** = 5.1 – 7.2
Notes: Good floc observed

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	120	20.5	100	14.1
Mixing Sensitivity	125	87.7	100	39.1
Temp Sensitivity, 5.5ºC	125	33.9	75	23.8

Sumalchlor 50

Date Run: 12/18/04, 14:25 – 18:00
Number of Jars: 38
Dose Range Tested: 0 – 400 mg/L **BTD =** 35 mg/L (product)
Temperature Range: 10.1 – 10.8 °C **pH Range** = 7.0 – 7.1
Notes: Only pin floc observed in lower doses

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	25	50.2	20	29.4
Mixing Sensitivity	20	156	20	72.6
Temp Sensitivity, 6.4 ºC	50	40.0	40	16.7

Jar Test Experiments **Run 19, Cont.**

Chemical

JC1720

Date Run: 12/17/04, 12:00 – 14:00
Number of Jars: 48
Dose Range Tested: 0 – 400 mg/L **BTD = 3**0 mg/L (product)
Temperature Range: 10.1 – 11.6 °C **pH Range** = 6.4-7.0
Notes: Nice, good settling floc observed

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	30	13.0	30	7.73
Mixing Sensitivity	75	61.1	30	22.9
Temp Sensitivity, 5.5 ºC	30	21.4	30	11.8

PAM #1
(Cytec A100)

Date Run: 12/17/04, 9:00 – 13:40
Number of Jars: 48
Dose Range Tested: 0 – 4.0 mg/L **BTD =** 2.75 mg/L (product)
Temperature Range: 9.4 – 10.4 °C **pH Range** = 7.2
Notes: Large, slow settling, dense, dark floc observed

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	2.75	19.6	2.75	17.1
Mixing Sensitivity	3.00	24.4	2.75	24.1
Temp Sensitivity, 4.9ºC	2.75	18.3	2.75	17.2

PAM #2
(Ciba Soilfix IR)

Date Run: 12/18/04, 9:10 – 11:45
Number of Jars: 32
Dose Range Tested: 0 – 3.0 mg/L **BTD =** 1.60 mg/L (product)
Temperature Range: 8.9-10.0 °C **pH Range** = 7.1-7.2
Notes: Fine floc observed, cloudy solution

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	1.40	51.4	1.60	48.1
Mixing Sensitivity	1.50	67.4	1.50	56.5
Temp Sensitivity, 5.6 ºC	1.50	68.3	2.00	51.3

Settling Test Experiments **Run 19**

Chemical

PAX-XL9

Date Run:	12/19/04	**Time Started:**	9:25
Target Dose:	100 mg/L	**Actual Dose:**	105 mg/L
Temp Range (ºC):	9.6-10.8	**pH:**	6.6

	Port A (top)	Port D (lower)
Turbidity measured after 8 hours	13.7 NTU	33.3 NTU
Estimated settling time required to 20 NTU	7.5 hrs	9.5 hrs

JC1720

Date Run:	12/19/04	**Time Started:**	9:50
Target Dose:	30 mg/L	**Actual Dose:**	32 mg/L
Temp Range (ºC):	9.5-10.4	**pH:**	7.0

	Port A (top)	Port D (lower)
Turbidity measured after 8 hours	12.7 NTU	14.3 NTU
Estimated settling time required to 20 NTU	7.0 hrs	7.2 hrs

PAM #1 (Cytec A100)

Date Run:	12/19/04	**Time Started:**	10:06
Target Dose:	2.75 mg/L	**Actual Dose:**	2.75 mg/L
Temp Range (ºC):	9.5 – 10.1	**pH:**	7.1

	Port A (top)	Port D (lower)
Turbidity measured after 8 hours	145 NTU	154 NTU
Estimated settling time required to 20 NTU	36.2 hrs	49.2 hrs

Control

Date Run:	12/19/04	**Time Started:**	10:15
Target Dose:	None	**Actual Dose:**	None
Temp Range (ºC):	9.4 – 11.3	**pH:**	7.3

	Port A (top)	Port D (lower)
Turbidity measured after 8 hours	728 NTU	771NTU
Estimated settling time required to 20 NTU	98.6 hrs	146 hrs

Experimental Run Summary - Run # 20

Run Number	20
Date Run	3/10/05 to 3/19/05
Water Source	Snowmelt water used for Run 20 was collected from the on-site basin on 3/10/05 (2,500 gallons) and 3/11/05 (2,000 gallons). Mix proportion: 100 % On-Site Basin
Weather	Climate station in South Lake Tahoe (airport) recorded a 5-day period of unseasonable warm temperatures contributing to a significant amount of snowmelt runoff. Daytime high temperatures during this period ranged from 50 to 65 ºF.
Storm Water Quality Characteristics	pH = 7.3 Phos-T = 1.24 mg-P/L, Phos-D = 0.08 mg-P/L Turbidity = 1764 NTU Temperature = 7.1 °C EC = 3,022 µS (Phosphorus spiked)
Laboratory	Pat-Chem

Operational Notes and Summary

4-Inch Columns **Operational Notes**

During Run 20, all columns were run continuously from 8:30 AM Sunday 3/13/05 to 9:00 AM Saturday 3/19/05 (6 days, 72 ft). Upon hydraulic failure (head > 42" above media) a filter was removed from service and "rebuilt" by replacing the protective sand cap with new, washed Superior 30 sand. Unlike with Run 18 and 19, a few columns required "reconstruction" (i.e. the removal of the upper few inches of media to restore flow). The clarifier was charged on Friday 3/11/05 and allowed equilibrate until use on 3/13/05. Filter effluent turbidity was measured daily. Samples for chemical analysis were collected on 3/15/05 (2 days into operation). Turbidity at the sand/media interface and 12-inch depth measured once (3/15/05) during the run.

Clarifier	Effluent Turbidity (NTU) -	627 (427-827)
	Effluent Phosphorus (mg/L) -	Phos-T = 0.58 mg-P/L, Phos-D = 0.04 mg-p/L
Columns 1 & 2	Existing Activated Alumina (28/48 mesh DD-2)	
	Filters Rebuilt -	Both filters rebuilt twice (Day 2 and 4). Second rebuild, 6" of media replaced.
	Head -	30-42", 42" after initial reconstruction, 12" after second reconstruction, 16" at end of run
	Effluent Turbidity (NTU) -	66.1 (0.5-119)
	Effluent Phos-T (mg/L) -	<0.03
Columns 3 & 4	Existing Fine Sand (Lapis F-105)	
	Filters Rebuilt -	Both filters #3 and #4 were not rebuilt during this run.
	Head -	7-11.5"
	Effluent Turbidity (NTU) -	166 (72.6-280)
	Effluent Phos-T (mg/L) -	0.07 – 0.12
Columns 5 & 6	Activated Alumina (28/48 mesh DD-2)	
	Filters Rebuilt -	#5 rebuilt on Day 3 and #6 was not rebuilt
	Head -	2.5-42", 13" after reconstruction, end run near 20"
	Effluent Turbidity (NTU) -	38.1 (11.6-64.3)
	Effluent Phos-T (mg/L) -	<0.03

4-Inch Columns	**Run 20 Operational Notes – Continued**	
Columns 7 & 8	Activated Alumina (14/28 mesh DD-2)	
	Filters Rebuilt -	Both filters#7 and #8 were not rebuilt during this run.
	Head -	2.5-15.75"
	Effluent Turbidity (NTU) -	115 (75.8-155)
	Effluent Phos-T (mg/L) -	0.06 – 0.08
Columns 9 & 10	Superior 30 Sand	
	Filters Rebuilt -	Filter #9 and #10 were rebuilt on Day 6.
	Head -	10.25-42", after reconstruction 9.5", 10 " at end of run
	Effluent Turbidity (NTU) -	134 (42.5-222)
	Effluent Phos-T (mg/L) -	0.06 – 0.11
Columns 11 & 12	Limestone (Teichert #4 Limestone Sand)	
	Filters Rebuilt -	Both filters were not rebuilt during this run
	Head -	7.5-34.5"
	Effluent Turbidity (NTU) -	140 (64.3-217)
	Effluent Phos-T (mg/L) -	0.05 – 0.11
Columns 13 & 14	Iron Modified Activated Alumina (Alcan)	
	Filters Rebuilt -	Filter #13 and #14 rebuilt on Day 3, #14 rebuilt again on Day 7.
	Head -	10.25-42", after initial reconstruction 5.5", at end of run 42".
	Effluent Turbidity (NTU) -	2.08 (0.19-3.7)
	Effluent Phos-T (mg/L) -	0.03
Columns 15 & 16	Granular Ferric Hydroxide (U.S. Filter)	
	Filters Rebuilt -	Both filters were not rebuilt during this run.
	Head -	10.5-35.25"
	Effluent Turbidity (NTU) -	148 (0.50-338)
	Effluent Phos-T (mg/L) -	0.03
Columns 17 & 18	Iron Oxide (Bayoxide E33, Severn Trent)	
	Filters Rebuilt -	Both filters were not rebuilt during this run.
	Head -	2.5-29"
	Effluent Turbidity (NTU) -	131 (40.1-226)
	Effluent Phos-T (mg/L) -	0.07 – 0.14

Jar Test Experiments **Run 20, Cont.**

Note: "Temperature Sensitivity" (cold) jars were not run because the bulk storm water used for the jar tests was approximately 5 ºC.

Chemical

PAX-XL9

Date Run: 3/12/05
Number of Jars: 21
Dose Range Tested: 0 – 500 mg/L **BTD** = 290 mg/L (product)
Temperature Range: 4.4 – 9.1°C **pH** = 6.2 – 7.4
Notes: Good floc observed

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	290	5.0	290	2.1
Mixing Sensitivity	200	24.6	150	12.2
Temp Sensitivity	Not run	Not run	Not run	Not run

PASS-C

Date Run: 3/13/05
Number of Jars: 21
Dose Range Tested: 0 – 500 mg/L **BTD =** 110 mg/L (product)
Temperature Range: 5.0 – 6.9 °C **pH Range** = 6.0 – 7.0
Notes: Good floc observed

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	110	14.1	110	5.1
Mixing Sensitivity	300	21.8	300	12.3
Temp Sensitivity	Not run	Not run	Not run	Not run

Sumalchlor 50

Date Run:
Number of Jars: 38
Dose Range Tested: 0 – 400 mg/L **BTD =** 45 mg/L (product)
Temperature Range: 5.0 – 8.4 °C **pH Range** = 6.8 – 7.5
Notes: Floc observed in lower doses only (<150 mg/L)

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	45	15.8	45	5.2
Mixing Sensitivity	50	33.8	50	14.8
Temp Sensitivity	Not run	Not run	Not run	Not run

Jar Test Experiments **Run 20, Cont.**

Chemical

JC1720

Date Run: 3/12/05
Number of Jars: 20
Dose Range Tested: 0 – 500 mg/L **BTD** = 240 mg/L (product)
Temperature Range: 4.2 – 7.4 °C **pH Range** = 6.2 - 7.2
Notes: Nice, good settling floc observed

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	250	6.1	240	3.3
Mixing Sensitivity	200	18.5	200	11.7
Temp Sensitivity	Not run	Not run	Not run	Not run

PAM #1
(Cytec A100)

Date Run: 12/17/04, 9:00 – 13:40
Number of Jars: 27
Dose Range Tested: 0 – 15.0 mg/L **BTD =** 10 mg/L (product)
Temperature Range: 5.0 – 8.3 °C **pH Range** = 7.0 – 7.2
Notes: Extremely high doses required for treatment

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	10.0	12.0	10.0	11.2
Mixing Sensitivity	8.0	41.2	8.0	41.2
Temp Sensitivity	Not run	Not run	Not run	Not run

PAM #2
(Ciba Soilfix IR)

Date Run: 3/13/05
Number of Jars: 23
Dose Range Tested: 0 – 10.0 mg/L **BTD =** 7.0 mg/L (product)
Temperature Range: 4.0 – 8.5 °C **pH Range** = 7.3 – 7.4
Notes: Extremely high doses required for treatment

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	7.0	38.2	7.0	21.2
Mixing Sensitivity	8.0	68.1	8.0	46.2
Temp Sensitivity	Not run	Not run	Not run	Not run

Settling Test Experiments **Run 20**

Chemical

PAX-XL9

Date Run:	3/15/05	**Time Started:**	9:00
Target Dose:	290 mg/L	**Actual Dose:**	290 mg/L
Temp Range (ºC):	5.6 – 7.6	**pH:**	6.3

	Port A (top)	Port D (lower)
Turbidity measured after 8 hours	9.2 NTU	11.0 NTU
Estimated settling time required to 20 NTU	5.0 hrs	5.5 hrs

JC1720

Date Run:	3/14/05	**Time Started:**	9:30
Target Dose:	240 mg/L	**Actual Dose:**	240 mg/L
Temp Range (ºC):	5.5 – 7.6	**pH:**	6.4

	Port A (top)	Port D (lower)
Turbidity measured after 8 hours	8.2 NTU	9.7 NTU
Estimated settling time required to 20 NTU	5.4 hrs	5.6 hrs

PAM #1 (Cytec A100)

Date Run:	3/14/05	**Time Started:**	10:00
Target Dose:	10.00 mg/L	**Actual Dose:**	9.82 mg/L
Temp Range (ºC):	5.6 – 7.7	**pH:**	7.2

	Port A (top)	Port D (lower)
Turbidity measured after 8 hours	27.8 NTU	27.9 NTU
Estimated settling time required to 20 NTU	32.5 hrs	50.1 hrs

Control

Date Run:	3/14/05	**Time Started:**	10:30
Target Dose:	None	**Actual Dose:**	None
Temp Range (ºC):	5.7 – 7.6	**pH:**	7.2

	Port A (top)	Port D (lower)
Turbidity measured after 8 hours	699 NTU	1,389 NTU
Estimated settling time required to 20 NTU	-	-

Experimental Run Summary - Run # 21

Run Number	21
Date Run	3/19/05
Water Source	Storm water runoff water used for Run 21 was collected from 9:00 am to 3:00 PM on 3/19/05 from three locations: Mix proportion: 40% (≈1,800 gallons) from the HY-89 Basin (9:00 am) 40% (≈1,800 gallons) from the Al Tahoe Jensen Box 20% (≈ 900 gallons) from the inlet at Ski Run Basin
Weather	Climate station in South Lake Tahoe (airport) recorded 0.75 inches of rain between 2 AM and 9 AM on 3/19/05. An additional 0.50 inches fell between 9 AM and 3 PM, the time sample collection was complete Air temperatures during this period ranged from 32 to 38 ºF.
Storm Water Quality Characteristics	pH = 7.4 Temperature = 6.3 °C EC = 636 µS Phos-T = 0.47 mg-P/L, Phos-D = 0.03 mg-P/L Turbidity 256 NTU
Laboratory	Pat-Chem

Operational Notes and Summary

4-Inch Columns — **Operational Notes**

During Run 21, all columns were run continuously from 9:00 AM Sunday 3/20/05 until 10:00 AM Saturday 3/26/05 (6 days, 72 ft). Upon hydraulic failure (head > 42" above media) a filter was removed from service and "rebuilt" by replacing the protective sand cap with new, washed Superior 30 sand. During Run 21, no filter columns required "reconstruction" (i.e. the removal of the upper few inches of media to restore flow); however, the level of media in columns #12, 13, 14, 15, 16 and 18 had settled, been lost or eroded anywhere from 0.5 to 1.5 inches below the sampling port at the sand media interface. If the sand cap was rebuilt for the previously mentioned columns, media was added to reach the centerline of the port. The clarifier was charged on Saturday 3/19/05 and allowed equilibrate until use on 3/20/05. Filter effluent turbidity was measured daily. Samples for chemical analysis were collected on 3/22/05 (2 days into operation). Turbidity at the sand/media interface and 12-inch depth measured once (3/22/05) during the run.

Clarifier	Effluent Turbidity (NTU) -	156 (156-182)
	Effluent Phosphorus (mg/L) -	Phos-T = 0.30 mg-P/L, Phos-D = < 0.03 mg-P/L
Columns 1 & 2	Existing Activated Alumina (28/48 mesh DD-2)	
	Filters Rebuilt -	Both filters were not rebuilt during this run.
	Head -	10.5-32"
	Effluent Turbidity (NTU) -	14.6 (7.6-19.9) – after equilibrium
	Effluent Phos-T (mg/L) -	0.04
Columns 3 & 4	Existing Fine Sand (Lapis F-105)	
	Filters Rebuilt -	Both filters were not rebuilt during this run.
	Head -	9.5-31.75"
	Effluent Turbidity (NTU) -	45 (16.9-86) – after equilibrium
	Effluent Phos-T (mg/L) -	0.04
Columns 5 & 6	Activated Alumina (28/48 mesh DD-2)	
	Filters Rebuilt -	Filter #5 was not rebuilt, and filter #6 was rebuilt on Day 4.
	Head -	12.5-42", 7.75" after reconstruction, end run near 15".
	Effluent Turbidity (NTU) -	12.3 (6.0-18.1) – after equilibrium
	Effluent Phos-T (mg/L) -	<0.03

4-Inch Columns	**Run 21 Operational Notes – Continued**	
Columns 7 & 8	Activated Alumina (14/28 mesh DD-2)	
	Filters Rebuilt -	Filters #7 was rebuilt on Day 4 and filter #8 was not rebuilt during this run.
	Head -	8-42", 9.5" after reconstruction, end run 12.5".
	Effluent Turbidity (NTU) -	23.5 (11.7-35.4) – after equilibrium
	Effluent Phos-T (mg/L) -	<0.03
Columns 9 & 10	Superior 30 Sand	
	Filters Rebuilt -	Both filters were not rebuilt during this run.
	Head -	9-38.25"
	Effluent Turbidity (NTU) -	51.2 (16.3-91.4)– after equilibrium
	Effluent Phos-T (mg/L) -	0.04
Columns 11 & 12	Limestone (Teichert #4 Limestone Sand)	
	Filters Rebuilt -	Filter #11 was not rebuilt and filter #12 was rebuilt on Day 4.
	Head -	10.5-42", after reconstruction 5.75", end run 12.75".
	Effluent Turbidity (NTU) -	41.5 (21.5-63.7) – after equilibrium
	Effluent Phos-T (mg/L) -	0.03
Columns 13 & 14	Iron Modified Activated Alumina (Alcan)	
	Filters Rebuilt -	Both filters were rebuilt on Day 2.
	Head -	14-42", after reconstruction 24.75", end run 42".
	Effluent Turbidity (NTU) -	2.7 (0.23-4.6) – after equilibrium
	Effluent Phos-T (mg/L) -	<0.03
Columns 15 & 16	Granular Ferric Hydroxide (U.S. Filter)	
	Filters Rebuilt -	Both filters were rebuilt on Day 2.
	Head -	18-42", after reconstruction 1.5", end run 36.75".
	Effluent Turbidity (NTU) -	7.2 (1.5-12.9) – after equilibrium
	Effluent Phos-T (mg/L) -	<0.03
Columns 17 & 18	Iron Oxide (Bayoxide E33, Severn Trent)	
	Filters Rebuilt -	Filter #17 was rebuilt on Day 5 and filter #18 was rebuilt on Day 2.
	Head -	6-42", after #18 reconstruction 12", after #17 reconstruction 2.5", end run 37.5".
	Effluent Turbidity (NTU) -	18.9 (2.5-36.5) – after equilibrium
	Effluent Phos-T (mg/L) -	0.03

Jar Test Experiments **Run 21, Cont.**

Note: "Temperature Sensitivity" (cold) jars were not run because the bulk storm water used for the jar tests was approximately 5 ºC.

Chemical

PAX-XL9

Date Run: 3/20/05
Number of Jars: 22
Dose Range Tested: 0 – 400 mg/L **BTD** = 90 mg/L (product)
Temperature Range: 3.2 – 5.6°C **pH** = 5.7 – 7.0
Notes: Good floc observed

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	110	11.1	100	5.9
Mixing Sensitivity	140	45.6	140	20.4
Temp Sensitivity	Not run	Not run	Not run	Not run

PASS-C

Date Run: 3/21/04
Number of Jars: 17
Dose Range Tested: 0 – 400 mg/L **BTD =** 100 mg/L (product)
Temperature Range: 3.1 – 8.3 °C **pH Range** = 5.4 – 7.4
Notes: Good floc observed

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	125	10.9	100	7.1
Mixing Sensitivity	70	127	140	21.7
Temp Sensitivity	Not run	Not run	Not run	Not run

Sumalchlor 50

Date Run: 3/24/05
Number of Jars: 22
Dose Range Tested: 0 – 400 mg/L **BTD =** 25 mg/L (product)
Temperature Range: 5.2 – 7.9 °C **pH Range** = 6.2 – 7.2
Notes: Floc observed in lower doses (<75 mg/L)

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	25	18.4	25	11.0
Mixing Sensitivity	20	84.2	20	37.1
Temp Sensitivity	Not run	Not run	Not run	Not run

Jar Test Experiments **Run 21, Cont.**

Chemical

JC1720

Date Run: 3/20/05
Number of Jars: 17
Dose Range Tested: 0 – 400 mg/L **BTD** = 100 mg/L (product)
Temperature Range: 3.2 – 5.9 °C **pH Range** = 5.6 – 7.1
Notes: Nice, good settling floc observed

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	60	11.1	100	7.4
Mixing Sensitivity	80	60.3	70	18.3
Temp Sensitivity	Not run	Not run	Not run	Not run

PAM #1
(Cytec A100)

Date Run: 3/20/05
Number of Jars: 22
Dose Range Tested: 0 – 4.0 mg/L **BTD =** 0.35 mg/L (product)
Temperature Range: 3.2 – 6.1 °C **pH Range** = 7.3 – 7.5
Notes: Large, slow settling, dense, dark floc observed

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	0.25	37.3	0.35	35.3
Mixing Sensitivity	0.15	70.9	0.15	53.0
Temp Sensitivity	Not run	Not run	Not run	Not run

PAM #2
(Ciba Soilfix IR)

Date Run: 3/21/05
Number of Jars: 21
Dose Range Tested: 0 – 4.0 mg/L **BTD** = 0.10 mg/L (product)
Temperature Range: 5.1 – 7.0 °C **pH Range** = 7.4
Notes: Fine floc observed, cloudy solution

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	0.10	78.5	0.10	67.6
Mixing Sensitivity	0.10	126	0.10	104
Temp Sensitivity	Not run	Not run	Not run	Not run

Settling Test Experiments **Run 21**

Chemical

PAX-XL9

Date Run:	3/24/05	**Time Started:**	9:04
Target Dose:	90 mg/L	**Actual Dose:**	92 mg/L
Temp Range (ºC):	7.3 – 8.6	**pH:**	6.9

	Port A (top)	Port D (lower)
Turbidity measured after 8 hours	5.3 NTU	7.1 NTU
Estimated settling time required to 20 NTU	5.0 hrs	5.4 hrs

JC1720

Date Run:	3/24/05	**Time Started:**	9:20
Target Dose:	100 mg/L	**Actual Dose:**	100 mg/L
Temp Range (ºC):	7.3 – 8.0	**pH:**	6.9

	Port A (top)	Port D (lower)
Turbidity measured after 8 hours	5.4 NTU	6.3 NTU
Estimated settling time required to 20 NTU	5.6 hrs	5.8 hrs

PAM #1 (Cytec A100)

Date Run:	3/24/05	**Time Started:**	9:38
Target Dose:	0.35 mg/L	**Actual Dose:**	0.35 mg/L
Temp Range (ºC):	7.4 – 8.4	**pH:**	7.3

	Port A (top)	Port D (lower)
Turbidity measured after 8 hours	114 NTU	123 NTU
Estimated settling time required to 20 NTU	39.1 hrs	45.2 hrs

Control

Date Run:	3/24/05	**Time Started:**	9:54
Target Dose:	None	**Actual Dose:**	None
Temp Range (ºC):	7.2 – 8.3	**pH:**	7.4

	Port A (top)	Port D (lower)
Turbidity measured after 8 hours	210 NTU	232NTU
Estimated settling time required to 20 NTU	41.0 hrs	58.6 hrs

Experimental Run Summary - Run # 22

Run Number	22
Date Run	4/22/05 to 4/30/05
Water Source	Snowmelt water used for Run 22 was collected from the on-site basin on 4/21/05 (3,000 gallons) and 4/22/05 (1,500 gallons). Mix proportion: 100 % On-Site Basin
Weather	Climate station in South Lake Tahoe (airport) recorded warm temperatures contributing to a significant amount of snowmelt runoff. Daytime high temperatures during this period ranged from 45 to 62 ºF.
Storm Water Quality Characteristics	pH = 7.5 EC = 3,616 µS Temperature = 13.3 °C Turbidity = 408 NTU A HACH field test kit was used to measure the concentration of dissolved phosphorous in the snowmelt water collected. The test indicated that dissolved phosphorous was below 0.1 mg-P/L; therefore, the collected water was spiked with a phosphorous salt to bring the level up to approximately 0.1 mg-P/L. Total Phosphorus = 0.61 mg-P/L Dissolved Phosphorus = 0.08 mg-P/L
Laboratory	Pat-Chem

Operational Notes and Summary

4-Inch Columns	**Operational Notes**	
	During Run 22, all columns were run continuously from 8:00 AM Saturday 4/23/05 to 8:30 AM Saturday 4/30/05 (7 days, 84 ft). Upon hydraulic failure (head > 42" above media) a filter was removed from service and "rebuilt" by replacing the protective sand cap with new, washed Superior 30 sand. During Run 22, a few columns required "reconstruction" (i.e. the removal of the upper few inches of media to restore flow). The clarifier was charged on Friday 4/22/05 and allowed to equilibrate until use on 4/23/05. Filter effluent turbidity was measured daily. Samples for chemical analysis were collected on 4/25/05 (2.5 days into operation). Turbidity at the sand/media interface and 12-inch depth measured once (4/26/05) during the run.	
Clarifier	Effluent Turbidity (NTU) -	266 (245-303)
	Effluent Phosphorus (mg/L) -	Phos-T = 0.32 mg-P/L, Phos-D = 0.14 mg-P/L
Columns 1 & 2	Existing Activated Alumina (28/48 mesh DD-2)	
	Filters Rebuilt -	Both filters rebuilt once on Day 4.
	Head -	21-42", 19" after rebuild, 19" at end of run
	Effluent Turbidity (NTU) -	2.1 (0.31-3.6)
	Effluent Phos-T (mg/L) -	< 0.03 – 0.11
Columns 3 & 4	Existing Fine Sand (Lapis F-105)	
	Filters Rebuilt -	Filter #3 was rebuilt on Day 6 and #4 was not rebuilt during this run.
	Head -	20-42", 7" after rebuild, 7" at end of run.
	Effluent Turbidity (NTU) -	38.7 (24.2-52.4)
	Effluent Phos-T (mg/L) -	0.19
Columns 5 & 6	Activated Alumina (28/48 mesh DD-2)	
	Filters Rebuilt -	Filter #5 was rebuilt on Day 2 and #6 was rebuilt on Day 6.
	Head -	19-42", 22" after rebuild, at end of run 14"
	Effluent Turbidity (NTU) -	3.8 (0.34-7.74)
	Effluent Phos-T (mg/L) -	0.10

4-Inch Columns	Run 22 Operational Notes – Continued	
Columns 7 & 8	Activated Alumina (14/28 mesh DD-2)	
	Filters Rebuilt -	Both filters #7 and #8 were not rebuilt during this run.
	Head -	14-42”
	Effluent Turbidity (NTU) -	14.9 (5.4-25.3)
	Effluent Phos-T (mg/L) -	0.10
Columns 9 & 10	Superior 30 Sand	
	Filters Rebuilt -	Filter #9 was rebuilt on Day 1 and #10 was rebuilt on Day 4.
	Head -	23-42”, after rebuild 10”, at end of run 9”.
	Effluent Turbidity (NTU) -	39.8 (26.2-52.8)
	Effluent Phos-T (mg/L) -	0.17
Columns 11 & 12	Limestone (Teichert #4 Limestone Sand)	
	Filters Rebuilt -	Filter #11 was rebuilt on Day 1 and #12 was rebuilt on Day 6.
	Head -	25-42”, after rebuild 20”, at end of run 7”.
	Effluent Turbidity (NTU) -	52.1 (35.4-69.4)
	Effluent Phos-T (mg/L) -	0.18 – 0.42
Columns 13 & 14	Iron Modified Activated Alumina (Alcan)	
	Filters Rebuilt -	Filters #13 and #14 were initially rebuilt on Day 2. On Day 4, 6” of clogged media was replaced in both filters. Due to continuous hydraulic failure, these columns were taken off line on Day 6.
	Head -	21-42”, after rebuild 32”, after replacement of media 8”, at end of run 42”.
	Effluent Turbidity (NTU) -	2.2 (0.30-4.44)
	Effluent Phos-T (mg/L) -	0.11 – 0.17
Columns 15 & 16	Granular Ferric Hydroxide (U.S. Filter)	
	Filters Rebuilt -	Filter #15 was rebuilt on Day 4 and #16 was rebuilt on Day 6.
	Head -	11-42”, after sand cap replacement 19”, at end of run 24”.
	Effluent Turbidity (NTU) -	20.4 (1.95-33.6)
	Effluent Phos-T (mg/L) -	0.15 – 0.38
Columns 17 & 18	Iron Oxide (Bayoxide E33, Severn Trent)	
	Filters Rebuilt -	Filter #17 was not rebuilt, and #18 was initially rebuilt on Day 1 and rebuilt again (with 2” of media and sand cap replaced) on Day 2.
	Head -	22-42”, after sand cap replacement 42”, after media and sand cap replacement 22”, at end of run 13”.
	Effluent Turbidity (NTU) -	16.0 (0.51-30.9)
	Effluent Phos-T (mg/L) -	0.10 – 0.19

Jar Test Experiments **Run 22, Cont.**

Chemical

PAX-XL9

Date Run: 4/23/05
Number of Jars: 24
Dose Range Tested: 0 – 400 mg/L **BTD** = 125 mg/L (product)
Temperature Range: 7.4 – 9.6°C **pH** = 5.5 – 7.4
Notes: Good floc observed

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	125	8.9	75	5.6
Mixing Sensitivity	50	52.8	50	27.1
Temp Sensitivity	100	13.9	100	10.6

PASS-C

Date Run: 4/28/05
Number of Jars: 24
Dose Range Tested: 0 – 400 mg/L **BTD =** 100 mg/L (product)
Temperature Range: 11.9 – 13.0 °C **pH Range** = 5.2 – 7.4
Notes: Good floc observed

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	100	7.9	100	4.3
Mixing Sensitivity	75	28.0	75	20.4
Temp Sensitivity	75	15.0	25	9.9

Sumalchlor 50

Date Run: 4/24/05
Number of Jars: 30
Dose Range Tested: 0 – 400 mg/L **BTD =** 30 mg/L (product)
Temperature Range: 7.2 – 10.4 °C **pH Range** = 6.3 – 7.4
Notes: Floc observed in lower doses only (<100 mg/L)

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	20	28.6	30	12.1
Mixing Sensitivity	30	89.8	30	46.5
Temp Sensitivity	20	28.7	30	15.1

Jar Test Experiments **Run 22, Cont.**

Chemical

JC1720

Date Run: 4/22/05
Number of Jars: 24
Dose Range Tested: 0 – 400 mg/L **BTD** = 175 mg/L (product)
Temperature Range: 7.2 – 9.8 °C **pH Range** = 5.7 - 7.4
Notes: Good settling floc observed

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	175	6.0	175	3.9
Mixing Sensitivity	200	32.0	100	21.3
Temp Sensitivity	150	8.7	50	6.0

PAM #1
(Cytec A100)

Date Run: 4/23/05
Number of Jars: 30
Dose Range Tested: 0 – 10.0 mg/L **BTD =** 4.0 mg/L (product)
Temperature Range: 7.5 – 10.1 °C **pH Range** = 7.5
Notes: High doses required for treatment

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	4.0	9.1	4.0	8.7
Mixing Sensitivity	2.0	36.6	4.0	19.9
Temp Sensitivity	4.0	19.4	4.0	13.4

PAM #2
(Ciba Soilfix IR)

Date Run: 4/23/05
Number of Jars: 29
Dose Range Tested: 0 – 10.0 mg/L **BTD =** 2.5 mg/L (product)
Temperature Range: 7.3 – 10.1 °C **pH Range** = 7.6
Notes: Higher doses (> 1 mg/L) required for treatment

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	2.0	37.7	2.5	33.6
Mixing Sensitivity	1.5	66.0	2.0	42.3
Temp Sensitivity	1.5	41.6	3.0	37.8

Settling Test Experiments **Run 22**

Chemical

PAX-XL9

Date Run:	4/29/05	**Time Started:**	9:00
Target Dose:	125 mg/L	**Actual Dose:**	125 mg/L
Temp Range (ºC):	13.7 – 14.0	**pH:**	6.7

	Port A (top)	Port D (lower)
Turbidity measured after 8 hours	9.0 NTU	10.7 NTU
Estimated settling time required to 20 NTU	5.9 hrs	6.3 hrs

JC1720

Date Run:	4/29/05	**Time Started:**	9:30
Target Dose:	175 mg/L	**Actual Dose:**	174 mg/L
Temp Range (ºC):	13.5 – 14.0	**pH:**	6.4

	Port A (top)	Port D (lower)
Turbidity measured after 8 hours	7.2 NTU	10.2 NTU
Estimated settling time required to 20 NTU	5.6 hrs	6.5 hrs

PAM #1 (Cytec A100)

Date Run:	4/29/05	**Time Started:**	10:00
Target Dose:	4.00 mg/L	**Actual Dose:**	3.96 mg/L
Temp Range (ºC):	14.3 – 14.7	**pH:**	7.2

	Port A (top)	Port D (lower)
Turbidity measured after 8 hours	40.0 NTU	45.1 NTU
Estimated settling time required to 20 NTU	61.3 hrs	44.2 hrs

Control

Date Run:	4/29/05	**Time Started:**	10:30
Target Dose:	None	**Actual Dose:**	None
Temp Range (ºC):	14.0 – 14.2	**pH:**	7.2

	Port A (top)	Port D (lower)
Turbidity measured after 8 hours	352 NTU	376 NTU
Estimated settling time required to 20 NTU	42.1 hrs	40.0 hrs

Experimental Run Summary - Run # 23

Run Number	**23**
Date Run	4/29/05 to 5/7/05
Water Source	Roadway runoff water used for Run 23 was collected from the HY-89 Basin on 4/27/05 (2,000 gallons) and 4/28/05 (2,500 gallons). Mix proportion: 100 % HY-89 Basin
Weather	Climate station in South Lake Tahoe (airport) recorded 0.30" of rainfall during water collection days (4/27 and 4/28). This rainfall event contributed to roadway run-off which filled the basin off Highway 89.
Storm Water Quality Characteristics	pH = 7.4 EC = 556 μS Temperature = 10.6 °C Turbidity = 316 NTU A HACH field test kit was used to measure the concentration of dissolved phosphorous in the rain event runoff water collected. The test indicated that dissolved phosphorous was below 0.1 mg-P/L; therefore, the collected water was spiked with a phosphorous salt to bring the level up to approximately 0.1 mg-P/L. Total Phosphorus = 0.48 mg-P/L Dissolved Phosphorus = 0.20 mg-P/L
Laboratory	Pat-Chem

Operational Notes and Summary

4-Inch Columns	Operational Notes	
	During Run 23, all columns were run continuously from 10:00 AM Saturday 4/30/05 to 10:00 AM Saturday 5/7/05 (7 days, 84 ft). Upon hydraulic failure (head > 42" above media) a filter was removed from service and "rebuilt" by replacing the protective sand cap with new, washed Superior 30 sand. Because of hydraulic failure observed in Run 22, before beginning this run columns #13 and #14 (Iron Modified Activated Alumina) had the protective sand cap and 12" of media removed. The sand cap was replaced (new material); however, no new media was added to these columns, leaving 12" of media for treatment. Columns #4 and #8 were rebuilt prior to the start of Run 23. The clarifier was charged on Friday 4/29/05 and allowed equilibrate until use on 4/30/05. Filter effluent turbidity was measured daily. Samples for chemical analysis were collected on 5/2/05 (2 days into operation). Turbidity at the sand/media interface and 12-inch depth measured once (5/3/05) during the run.	
Clarifier	Effluent Turbidity (NTU) -	198 (175-214)
	Effluent Phosphorus (mg/L) -	Phos-T = 0.34 mg-P/L, Phos-D = 0.28 mg-P/L
Columns 1 & 2	Existing Activated Alumina (28/48 mesh DD-2)	
	Filters Rebuilt -	Filters #1 and #2 were not rebuilt during this run.
	Head -	13-42"
	Effluent Turbidity (NTU) -	25.3 (5.3-45.4)
	Effluent Phos-T (mg/L) -	< 0.03
Columns 3 & 4	Existing Fine Sand (Lapis F-105)	
	Filters Rebuilt -	Filters #3 and #4 were not rebuilt during this run.
	Head -	4-27"
	Effluent Turbidity (NTU) -	55.5 (38.7-71.3)
	Effluent Phos-T (mg/L) -	0.27
Columns 5 & 6	Activated Alumina (28/48 mesh DD-2)	
	Filters Rebuilt -	Filters #5 and #6 were not rebuilt during this run.
	Head -	9-26"
	Effluent Turbidity (NTU) -	44.1 (11.8-77.2)
	Effluent Phos-T (mg/L) -	< 0.03

4-Inch Columns	**Run 23 Operational Notes – Continued**	
Columns 7 & 8	Activated Alumina (14/28 mesh DD-2)	
	Filters Rebuilt -	Filters #7 and #8 were not rebuilt during this run.
	Head -	8-42”
	Effluent Turbidity (NTU) -	65.8 (24.9-105)
	Effluent Phos-T (mg/L) -	< 0.03
Columns 9 & 10	Superior 30 Sand	
	Filters Rebuilt -	Filters #9 and #10 were not rebuilt during this run.
	Head -	9-21”
	Effluent Turbidity (NTU) -	77.7(47.8-112)
	Effluent Phos-T (mg/L) -	0.26
Columns 11 & 12	Limestone (Teichert #4 Limestone Sand)	
	Filters Rebuilt -	Filters #11 and #12 were not rebuilt during this run.
	Head -	5-21”
	Effluent Turbidity (NTU) -	53 (45.4-61.8)
	Effluent Phos-T (mg/L) -	0.25
Columns 13 & 14	Iron Modified Activated Alumina (Alcan)	
	Filters Rebuilt -	Filter #13 and #14 were not rebuilt during this run.
	Head -	11-18”
	Effluent Turbidity (NTU) -	42.7 (37.4-47.9)
	Effluent Phos-T (mg/L) -	< 0.03
Columns 15 & 16	Granular Ferric Hydroxide (U.S. Filter)	
	Filters Rebuilt -	Filters #15 and #16 were not rebuilt during this run.
	Head -	19-37”
	Effluent Turbidity (NTU) -	46.2 (30.2-63.6)
	Effluent Phos-T (mg/L) -	< 0.03
Columns 17 & 18	Iron Oxide (Bayoxide E33, Severn Trent)	
	Filters Rebuilt -	Filters #17 and #18 were not rebuilt during this run.
	Head -	8-42”
	Effluent Turbidity (NTU) -	49.6 (27.2-79.3)
	Effluent Phos-T (mg/L) -	< 0.03

Jar Test Experiments **Run 23, Cont.**

Chemical

PAX-XL9

Date Run: 4/30/05
Number of Jars: 33
Dose Range Tested: 0 – 650 mg/L **BTD** = 250 mg/L (product)
Temperature Range: 10.0 – 10.5°C **pH** = 6.4 – 7.5
Notes: Good floc observed

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	200	5.1	250	2.5
Mixing Sensitivity	300	11.7	300	5.8
Temp Sensitivity	400	1.4	400	0.95

PASS-C

Date Run: 4/30/05
Number of Jars: 32
Dose Range Tested: 0 – 700 mg/L **BTD =** 400 mg/L (product)
Temperature Range: 10.0 – 11.0 °C **pH Range** = 6.5 – 7.5
Notes: Good floc observed

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	125	3.6	400	2.0
Mixing Sensitivity	400	9.7	400	5.2
Temp Sensitivity	300	5.9	300	4.3

Sumalchlor 50

Date Run: 5/1/05
Number of Jars: 27
Dose Range Tested: 0 – 400 mg/L **BTD =** 130 mg/L (product)
Temperature Range: 10.0 – 11.6 °C **pH Range** = 6.9 – 7.6
Notes: Good floc noted in a wider range of doses than typically observed with this coagulant

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	130	7.6	130	4.7
Mixing Sensitivity	75	52.6	75	12.0
Temp Sensitivity	50	19.2	50	6.5

Jar Test Experiments **Run 23, Cont.**

Chemical

JC1720

Date Run: 4/30/05
Number of Jars: 29
Dose Range Tested: 0 – 650 mg/L **BTD** = 200 mg/L (product)
Temperature Range: 10.0 – 10.9 °C **pH Range** = 6.6 - 7.7
Notes: Nice, good settling floc observed with very low turbidities recorded after 15 minutes of settling

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	200	3.4	200	2.5
Mixing Sensitivity	300	16.1	200	5.7
Temp Sensitivity	400	5.7	200	1.5

PAM #1
(Cytec A100)

Date Run: 5/1/05
Number of Jars: 24
Dose Range Tested: 0 – 4.0 mg/L **BTD =** 1.0 mg/L (product)
Temperature Range: 10.1 – 11.0 °C **pH Range** = 7.4 - 7.5
Notes: Normal doses (<1 mg/L) required for treatment

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	1.0	22.6	1.0	20.5
Mixing Sensitivity	0.5	33.9	1.0	26.6
Temp Sensitivity	0.75	26.6	1.0	22.5

PAM #2
(Ciba Soilfix IR)

Date Run: 5/1/05
Number of Jars: 29
Dose Range Tested: 0 – 4.0 mg/L **BTD =** 0.5 mg/L (product)
Temperature Range: 9.9 – 10.1 °C **pH Range** = 7.7 – 7.8
Notes: Normal doses (<1 mg/L) required for treatment , however unable to attain turbidities below the 20 NTU target

	Lowest Turbidity Recorded			
	15 min. Settling		60 min. Settling	
Test Condition	(mg/L)	(NTU)	(mg/L)	(NTU)
Standard Mixing	0.5	43.6	0.5	42.9
Mixing Sensitivity	1.0	85.0	1.0	72.3
Temp Sensitivity	0.25	46.8	0.25	45.0

Settling Test Experiments **Run 23**

Chemical

PAX-XL9

Date Run:	5/2/05	**Time Started:**	9:00
Target Dose:	250 mg/L	**Actual Dose:**	247 mg/L
Temp Range (ºC):	14.5 – 15.0	**pH:**	6.7

	Port A (top)	Port D (lower)
Turbidity measured after 8 hours	3.6 NTU	2.9 NTU
Estimated settling time required to 20 NTU	0.6 hrs	0.7 hrs

JC1720

Date Run:	5/2/05	**Time Started:**	9:30
Target Dose:	200 mg/L	**Actual Dose:**	201 mg/L
Temp Range (ºC):	15.0 – 15.5	**pH:**	6.8

	Port A (top)	Port D (lower)
Turbidity measured after 8 hours	2.8 NTU	3.6 NTU
Estimated settling time required to 20 NTU	0.9 hrs	1.9 hrs

PAM #1 (Cytec A100)

Date Run:	5/2/05	**Time Started:**	10:00
Target Dose:	1.00 mg/L	**Actual Dose:**	0.99 mg/L
Temp Range (ºC):	11.4 – 12.2	**pH:**	7.6

	Port A (top)	Port D (lower)
Turbidity measured after 8 hours	68.1 NTU	72.6 NTU
Estimated settling time required to 20 NTU	38.3 hrs	50.1 hrs

Control

Date Run:	5/2/05	**Time Started:**	10:30
Target Dose:	None	**Actual Dose:**	None
Temp Range (ºC):	11.4 – 11.9	**pH:**	7.6

	Port A (top)	Port D (lower)
Turbidity measured after 8 hours	231 NTU	236 NTU
Estimated settling time required to 20 NTU	59.9 hrs	123 hrs

Experimental Run Summary - Run # 24

Run Number	24
Date Run	5/14/05 to 5/21/05
Water Source	Snowmelt and rain water used for Run 24 was collected from the on-site basin on 5/13/05 (3,500 gallons). Mix proportion: 100 % On-Site Basin
Weather	The five days preceding sample collection had significant rainfall; however, there was no rainfall recorded on the day of (5/13/05) and the day proceeding (5/12/05) sample collection. Climate station in South Lake Tahoe (airport) recorded 0.32" of rainfall on 5/8/05, 0.35" on 5/9/05, 0.05" on 5/10/05, and 0.02" on the 5/11/05. Maximum air temperatures on the day before and the day of sample collection were 60 and 64 °F, respectively. On-site basin was completely filled with settled runoff and snowmelt from the adjacent snow pile.
Storm Water Quality Characteristics	pH = 8.1 EC = 440 µS Temperature = 13.8 °C Turbidity = 429 NTU A phosphorous field test kit was used to estimate the level of dissolved phosphorous. The test sample had a yellow tint that interfered with the blue endpoint; however, the test did not indicate the presence dissolved phosphorous. On 5/13/05, the water collected was spiked with sodium phosphate. Total Phosphorus = 0.64 mg-P/L Dissolved Phosphorus = 0.33 mg-P/L
Laboratory	Pat-Chem

Operational Notes and Summary

4-Inch Columns **Operational Notes**

During Run 24, all columns were run continuously from 10:00 AM Saturday 5/14/05 to 10:00 AM Saturday 5/21/05 (7 days, 84 ft). Upon hydraulic failure (head > 42" above media) a filter was removed from service and "rebuilt" by replacing the protective sand cap with new, washed Superior 30 sand. In Run 24 many columns required "reconstruction" (i.e. the removal of the upper few inches of media to restore flow). Before beginning this run, no columns were rebuilt. The clarifier was charged on Friday 5/13/05 and allowed to equilibrate until use on 5/14/05. Filter effluent turbidity was measured daily. Samples for chemical analysis were collected on 5/17/05 (3 days into operation). Turbidity at the sand/media interface and 12-inch depth was measured once (5/17/05) during the run.

Clarifier	Effluent Turbidity (NTU) -	330 (291-404)
	Effluent Phosphorus (mg/L) -	Phos-T = 0.55 mg-P/L, Phos-D = 0.32 mg-P/L
Columns 1 & 2	Existing Activated Alumina (28/48 mesh DD-2)	
	Filters Rebuilt -	Filters #1 and #2 were initially rebuilt on Day 2. On Day 3, 1" of media was replaced on each column, and on Day 5, 6" of media was replaced.
	Head -	1.5-42", after initial rebuild 20", after first media replacement 37", after second media replacement 16", and at end of run 30".
	Effluent Turbidity (NTU) -	16.9 (0.63-40.3)
	Effluent Phos-T (mg/L) -	< 0.03
Columns 3 & 4	Existing Fine Sand (Lapis F-105)	
	Filters Rebuilt -	Filters #3 and #4 were not rebuilt during this run.
	Head -	1.5-20"
	Effluent Turbidity (NTU) -	172 (120-226)
	Effluent Phos-T (mg/L) -	0.40 – 0.44
Columns 5 & 6	Activated Alumina (28/48 mesh DD-2)	
	Filters Rebuilt -	Filters #5 and #6 were rebuilt (sand cap) on Day 2. On Day 5, 1" of media was replaced on each column, and on Day 6, 3" of media was replaced on filter #6 only.
	Head -	1.5-42", after initial rebuild 16", after first media replacement 14", after second media replacement (filter #6 only) 24", and at end of run 24".
	Effluent Turbidity (NTU) -	25.1 (0.51-52.4)
	Effluent Phos-T (mg/L) -	< 0.03

4-Inch Columns	**Run 24 Operational Notes – Continued**	
Columns 7 & 8	Activated Alumina (14/28 mesh DD-2)	
	Filters Rebuilt -	Filters #7 was rebuilt on Day 2. Filter #8 was not rebuilt during this run.
	Head -	1.5-42", after rebuild 14.5", at end of run 19".
	Effluent Turbidity (NTU) -	41.6 (2.69-101)
	Effluent Phos-T (mg/L) -	< 0.03
Columns 9 & 10	Superior 30 Sand	
	Filters Rebuilt -	Filters #9 and #10 were not rebuilt during this run.
	Head -	1-35.5"
	Effluent Turbidity (NTU) -	186 (112-256)
	Effluent Phos-T (mg/L) -	0.42
Columns 11 & 12	Limestone (Teichert #4 Limestone Sand)	
	Filters Rebuilt -	Filters #11 and #12 were not rebuilt during this run.
	Head -	1.5-39"
	Effluent Turbidity (NTU) -	141 (95.7-186)
	Effluent Phos-T (mg/L) -	0.39
Columns 13 & 14	Iron Modified Activated Alumina (Alcan)	
	Filters Rebuilt -	Filter #13 and #14 were not rebuilt during this run.
	Head -	1.5-28"
	Effluent Turbidity (NTU) -	81.1 (37.9-128)
	Effluent Phos-T (mg/L) -	< 0.03
Columns 15 & 16	Granular Ferric Hydroxide (U.S. Filter)	
	Filters Rebuilt -	Filters #15 and #16 were initially rebuilt on Day 2. On Day 5, 1" of media was replaced on each column.
	Head -	1.5-42", after rebuild 28.5", after media replacement 9.5", at end of run 31".
	Effluent Turbidity (NTU) -	52.3 (0.51-127)
	Effluent Phos-T (mg/L) -	< 0.03
Columns 17 & 18	Iron Oxide (Bayoxide E33, Severn Trent)	
	Filters Rebuilt -	Filters #17 and #18 were rebuilt on Day 2.
	Head -	1-42", after rebuild 32.5", at end of run 23".
	Effluent Turbidity (NTU) -	80.3 (1.75-153)
	Effluent Phos-T (mg/L) -	< 0.03

Jar Test Experiments	**Run 24**	
		Not Run
Settling Test Experiments	**Run 24**	
		Not Run

4.2.2 Summary of 4-Inch Column Runs

A summary of the 4-inch filter column activity is displayed in Table 4-3. Included in this table are operation and maintenance notes on the 4-inch columns, the sources and characteristics of storm water used and the timeline and duration of each run event (18 – 24). Color-coding is used to indicate when a column was in or out of service, any overflow occurrences, flow stoppage and reconstruction activities.

4.2.3 Summary of Jar Test Runs

Summarized in Table 4-4 are the number of jars tested for each water and chemical, the storm water source and water quality, and the best selected dose for each chemical. The best dose was determined by running as few as six jars and as many as eighteen. The temperatures of the waters tested are also summarized in Table 4-4. During Runs 20 and 21, the temperature of the influent water was below 5^0C, and the “temperature sensitivity” tests were not run. The best dose and whether successful coagulation was observed varied with the source water. A full discussion of the jar test results is presented in the following chapter (Section 5.3).

4.2.4 Summary of the Chemically-Enhanced Sedimentation Experiments

Sedimentation rate experiments were performed as described in the M&O Plan. Key data on the conditions under which the various experimental runs were conducted are summarized in Table 4-5.

Table 4-3. Operational Summary Chart, 4-Inch Extended Run Filter Columns

Run	Date	Day	Storm Water Used[a]	Column Designation and Media[b]																		Notes
				1 EAA	2 EAA	3 EFS	4 EFS	5 AA	6 AA	7 AAA	8 AAA	9 S30	10 S30	11 LS	12 LS	13 FeAA	14 FeAA	15 GFH	16 GFH	17 Bay	18 Bay	
18	12/11/04	Sat		X-4	X-4	X-4	X-4	X-4	X-4	X-4	X-4	X-4	X-4	X-4	X-4	X-4	X-4	X-4	X-4	X-4	X-4	4 - Flow started at 8:00 am
	12/12/04	Sun	1/2 HY-89 +1/2 Ski Run	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	10 - Sand cap replaced with Superior 30 Sand
	12/13/04	Mon	Turb = 191 NTU	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	13-Overflow captured (1 to 6 gal.)
	12/14/04	Tue	pH = 7.2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	5 - End of Run 18
	12/15/04	Wed	EC = 2,037 µS	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
	12/16/04	Thu	Temp = 5.5 C	C-10	C-10	X	X	X	X	X	X	X	X	X	X	X	X	C-10	C-10	X	X	
	12/17/04	Fri		X	X	X	C-10	X	X	X	X	C-10	C-10	X	X	X	X	X	X	X	X	
	12/18/04	Sat	(Rain Event)	X	X	X	X	X	X	X	X	X	X	X	X	X	C-10	X	X	X	X	
	12/19/04	Sun		X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	O-13	X-5	X-5	X-5	X-5	X-5	O-13	
19	12/19/04	Sun	On-Site	X-1	X-1	X-1	X-1	C-10a	X-1	C-10a	X-1	X-1	X-1	C-10a	C-10a	X-1	X-1	X-1	X-1	X-1	C-10a	1 - Start Run 19, consecutive following Run 18
	12/20/04	Mon	Turb = 841 NTU	C-10	C-10	C-10	X	X	C-10	X	X	X	X	X	X	C-10	X	X	X	C-10	X	10 - Sand cap replaced with Superior 30 Sand
	12/21/04	Tue	pH = 7.4	X	X	X	C-10	X	X	X	C-10	X	X	X	X	X	X	C-10	C-10	X	X	10a - Sand cap replaced (replace prior to starting run)
	12/22/04	Wed	EC = 1,900 µS	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	5 - End of Run 19
	12/23/04	Thu	Temp = 9.5 C	X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	
	12/24/04	Fri																				
	12/25/04	Sat	(Rain Event)																			
	12/26/04	Sun																				
20	3/13/05	Sun	On-Site	X-3	X-3	X-3	X-3	X-3	X-3	X-3	X-3	X-3	X-3	X-3	X-3	X-3	X-3	X-3	X-3	X-3	X-3	3 - Flow started at 9:00 am
	3/14/05	Mon	Turb = 1,764 NTU	M-2	M-2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	2 - Columns reconstructed (new sand cap + 2" of new media)
	3/15/05	Tue	pH = 7.3	O-13	X	X	X	X	X	X	X	X	X	X	X	C-10	C-10	X	X	X	X	13 - Overflow captured (1 to 6 gal.)
	3/16/05	Wed	EC = 3,022 µS	M-6	M-6	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	10 - Sand cap replaced with Superior 30 Sand
	3/17/05	Thu	Temp = 7.1 C	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	6 - Columns reconstructed (new sand cap + 6" of new media)
	3/18/05	Fri	(Snowmelt)	X	X	X	X	C-10	X	X	X	C-10	C-10	X	X	X	X	X	X	X	X	12 - Minor overflow captured (0 to 1 gal.)
	3/19/05	Sat		X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	O-12	X-5	X-5	X-5	X-5	5 - End of Run 20
21	3/20/05	Sun	40% HY-89 +40% Al Tahoe	X-3	X-3	X-3	X-3	X-3	X-3	X-3	X-3	X-3	X-3	X-3	X-3	X-3	C-10a	X-3	X-3	X-3	X-3	3 - Start Run 21, consecutive with Run 20, started at 9:00 am
	3/21/05	Mon	JB +20% Ski Run	X	X	X	X	X	X	X	X	X	X	X	X	M-2	M-2	M-2	M-2	X	C-10	10a - Sand cap replaced (replace prior to starting run)
	3/22/05	Tue	Turb = 256 NTU	X	X	X	X	X	X	O-12	X	X	X	X	O-12	O-13	O-13	X	X	X	X	10 - Sand cap replaced with Superior 30 Sand
	3/23/05	Wed	pH = 7.4	X	X	X	X	X	C-10	C-10	X	X	X	X	C-10	O-13	O-13	X	O-12	X	X	2 - Columns reconstructed (new sand cap + 2" of new media)
	3/24/05	Thu	EC = 636 µS	X	X	X	X	X	X	X	X	X	X	X	X	X	O-13	X	X	X	X	12 - Minor overflow captured (0 to 1 gal.)
	3/25/05	Fri	Temp = 6.3 C	X	X	X	X	X	X	X	X	X	X	X	X	X	O-13	X	X	C-10	X	13 - Overflow captured (1 to 6 gal.)
	3/26/05	Sat	(Rain Event)	X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	O-13	X-5	X-5	X-5	X-5	5 - End of Run 21
22	4/23/05	Sat	On-Site	X-4	X-4	X-4	X-4	X-4	X-4	X-4	X-4	X-4	C-10	C-10	X-4	X-4	X-4	X-4	X-4	X-4	C-10	4 - Flow started at 8:00 am
	4/24/05	Sun	Turb = 408 NTU	X	X	X	X	C-10	X	X	X	X	X	X	X	C-10	C-10	X	X	X	M-9	10 - Sand cap replaced with Superior 30 Sand
	4/25/05	Mon	pH = 7.5	X	X	X	X	X	X	X	X	X	X	X	X	O-13	O-13	O-12	X	X	X	13 - Overflow captured (1 to 6 gal.)
	4/26/05	Tue	EC = 3,616 µS	C-10	C-10	X	X	X	X	X	X	C-10	X	X	X	M-6	M-6	X	C-10	X	X	9 - Columns reconstructed (new sand cap + 1" of new media)
	4/27/05	Wed	Temp = 13.3 C	X	X	X	X	X	X	X	X	X	X	X	X	O-13	O-13	X	O-13	X	X	12 - Minor overflow captured (0 to 1 gal.)
	4/28/05	Thu		X	X	C-10	X	X	C-10	X	X	X	X	X	C-10	T-16	T-16	C-10	X	X	X	6 - Columns reconstructed (new sand cap + 6" of new media)
	4/29/05	Fri	(Snowmelt)	X	X	X	X	X	X	X	X	X	X	X	X	T	T	X	X	X	X	16 - Flow terminated due to excessive head
	4/30/05	Sat		X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	X-5	T	T	X-5	X-5	X-5	X-5	5 - End of Run 22
23	4/30/05	Sat	HY-89	X-7	X-7	X-7	C-10a	X-7	X-7	X-7	C-10a	X-7	X-7	X-7	X-7	M-11	M-11	X-7	X-7	X-7	X-7	7 - Start Run 23, consecutive with Run 22, started at 10:00 am
	5/1/05	Sun	Turb = 316 NTU	X	X	X	X	X	X	X	X	X	X	X	X	Y	Y	X	X	X	X	10a - Sand cap replaced (replaced prior to starting run)
	5/2/05	Mon	pH = 7.4	X	X	X	X	X	X	X	X	X	X	X	X	Y	Y	X	X	X	X	11 - Columns had 12" of media excavated before starting run
	5/3/05	Tue	EC = 556 µS	X	X	X	X	X	X	X	X	X	X	X	X	Y	Y	X	X	X	X	12 - Minor overflow captured (0 to 1 gal.)
	5/4/05	Wed	Temp = 10.6 C	X	X	X	X	X	X	X	X	X	X	X	X	Y	Y	X	X	X	X	5 - End of Run 23
	5/5/05	Thu		X	X	X	X	X	X	X	X	X	X	X	X	Y	Y	X	X	X	X	
	5/6/05	Fri	(Rain Event)	X	X	X	X	X	X	X	X	X	X	X	X	Y	Y	X	X	X	X	
	5/7/05	Sat		O-12	O-12	X-5	X-5	X-5	X-5	O-12	X-5	X-5	X-5	X-5	X-5	Y-5	Y-5	X-5	X-5	O-12	X-5	
24	5/14/05	Sat	On-Site	X-7	X-7	X-7	X-7	X-7	X-7	X-7	X-7	X-7	X-7	X-7	X-7	Y-7	Y-7	X-7	X-7	X-7	X-7	7 - Flow started at 10:00 am
	5/15/05	Sun	Turb = 429 NTU	C-10	C-10	X	X	C-10	C-10	C-10	X	X	X	X	X	Y	Y	C-10	C-10	C-10	C-10	10 - Sand cap replaced with Superior 30 Sand
	5/16/05	Mon	pH = 8.1	M-9	M-9	X	X	O-13	O-13	X	X	X	X	X	X	Y	Y	O-13	O-13	O-13	X	9 - Columns reconstructed (new sand cap + 1" of new media)
	5/17/05	Tue	EC = 440 µS	O-13	O-13	X	X	O-13	O-13	X	X	X	X	X	X	Y	Y	O-13	O-13	O-13	X	13 - Overflow captured (1 to 6 gal.)
	5/18/05	Wed	Temp = 13.8 C	M-6	M-6	X	X	M-9	M-9	X	X	X	X	X	X	Y	Y	M-9	M-9	X	X	6 - Columns reconstructed (new sand cap + 6" of new media)
	5/19/05	Thu		X	X	X	X	X	M-8	X	X	X	X	X	X	Y	Y	O-12	O-12	X	X	8 - Columns reconstructed (new sand cap + 3" of new media)
	5/20/05	Fri	(Rain and Snowmelt)	X	X	X	X	X	X	X	X	X	X	X	X	Y	Y	X	X	X	X	12 - Minor overflow captured (0 to 1 gal.)
	5/21/05	Sat		X-21	X-21	X-21	X-21	X-21	X-21	X-21	X-21	X-21	X-21	X-21	X-21	Y-21	Y-21	X-21	X-21	X-21	X-21	21 - End of Phase IV experimental testing runs

[a] Storm WQ values represent the WQ of the raw source water

[b] Media Abbreviations: EAA = Existing Activated Alumina (28x48), EFS = Existing F-105 Sand, AA = Activated Alumina (28x48), AAA = Alt. Mesh Act. Alumina (14x28)
S30 = Superior 30 Sand, LS = Limestone, FeAA = Iron Modified Activated Alumina, GFH = Granular Ferric Hydroxide, Bay = Bayoxide E-33

Color Key			
X	On Line and In Service	Y	On Line and In Service with 12" of Media
O	Column Overflowing	C	Sand Cap Replacement
T	Terminated, Water Off	M	Media Replacement

Table 4-4. Summary of Jar Test Experiments

Date	Run#	Water Source and Type		Initial Water Water Quality		Observations and Measurements	Chemical					
							PAX-XL9	PASS-C	SumalChlor 50	Jenchem 1720	Superfloc A-100	SoilFix IR
11/12/04	17A	100% On-Site Basin				Number of Jars Run (#) =	36	36	35	33	32	36
			Rain	Turb =	190 NTU	Temperature of Jars (°C) =	7.5-8.8	7.2-9.0	5.5-9.2	7.8-8.5	8.2-10.0	5.5-8.1
			Event	pH =	7.2	Final Selected Dose[a] (mg/L) =	70	50	25	120	1.20	0.80
				EC =	>4,000 µS	Coagulation & Settling =	OK	Poor	Poor	OK	OK	Poor
12/09/04	18	50% HY-89 + 50% Ski Run				Number of Jars Run (#) =	49	40	38	48	48	32
			Rain	Turb =	191 NTU	Temperature of Jars (°C) =	6.3-7.4	5.7-7.4	4.4-7.2	6.1-8.1	5.9-7.0	6.0-7.7
			Event	pH =	7.2	Final Selected Dose (mg/L) =	100	100	35	80	0.5	0.2
				EC =	2,037 µS	Coagulation & Settling =	OK	OK	Poor	OK	Poor	Poor
12/19/04	19	100% On-Site Basin				Number of Jars Run (#) =	32	40	38	48	48	32
			Rain	Turb =	841 NTU	Temperature of Jars (°C) =	9.8-11.1	9.3-11.1	10.1-10.8	10.1-11.6	9.4-10.4	8.9-10.0
			Event	pH =	7.4	Final Selected Dose (mg/L) =	100	100	35	30	2.75	1.60
				EC =	1,900 µS	Coagulation & Settling =	Poor	Poor	Poor	OK	OK	Poor
3/10/05	20	100% On-Site Basin				Number of Jars Run (#) =	21	21	38	20	27	23
			Snow	Turb =	1,764 NTU	Temperature of Jars (°C) =	4.4-9.1	5.0-6.9	5.0-8.4	4.2-7.4	5.0-8.3	4.0-8.5
			Melt	pH =	7.3	Final Selected Dose (mg/L) =	290	110	45	240	10	7.0
				EC =	3,022 µS	Coagulation & Settling =	Good	OK	OK	Good	OK	Poor
3/19/05	21	40% HY-89 + 40% Al Tahoe Jensen Box + 20% Ski Run				Number of Jars Run (#) =	22	17	22	17	22	21
			Rain	Turb =	256 NTU	Temperature of Jars (°C) =	3.2-5.6	3.1-8.3	5.2-7.9	3.2-5.9	3.2-6.1	5.1-7.0
			Event	pH =	7.4	Final Selected Dose (mg/L) =	90	100	25	100	0.35	0.10
				EC =	636 µS	Coagulation & Settling =	OK	OK	OK	OK	Poor	Poor
4/21/05	22	100% On-Site Basin				Number of Jars Run (#) =	24	24	30	24	30	29
			Snow	Turb =	408 NTU	Temperature of Jars (°C) =	7.4-9.6	11.9-13.0	7.2-10.4	7.2-9.8	7.5-10.1	7.3-10.1
			Melt	pH =	7.5	Final Selected Dose (mg/L) =	125	100	30	175	4.0	2.5
				EC =	3,616 µS	Coagulation & Settling =	Good	Good	Poor	Good	Good	Poor
4/27/05	23	100% HY-89				Number of Jars Run (#) =	33	32	27	29	24	29
			Rain	Turb =	316 NTU	Temperature of Jars (°C) =	10.0-10.5	10.0-11.0	10.0-11.6	10.0-10.9	10.1-11.0	9.9-10.1
			Event	pH =	7.4	Final Selected Dose (mg/L) =	250	400	130	200	1.0	0.5
				EC =	556 µS	Coagulation & Settling =	Good	Good	Good	Good	Poor	Poor

Notes:

[a] Final selected dose expressed as mg/L as product.

Table 4-5. Summary of the Sedimentation Experiments

Date and Run	Water Source	Water Quality	Observations and Measurements	Chemical		
				PAX-XL9	JC1720	PAM #1
11/12/04 Run 17A	- Rain Event - 100% On-Site Basin	Turb = 190 NTU pH = 7.2 S.U. EC = 4,844 μS	Chemical Dose (mg/L) = Temperature (^{0}C) =	70 6.5-9.8	120 6.5-10.0	1.2 6.5-11.0
12/09/04 Run 18	- Rain Event - 50% HY-89 + 50% Ski Run	Turb = 191 NTU pH = 7.2 S.U. EC = 2,037 μS	Chemical Dose (mg/L) = Temperature (^{0}C) =	100 7.3-9.4	80 7.2-9.8	0.52 7.2-8.9
12/19/04 Run 19	- Rain Event - 100% On-Site Basin	Turb = 841 NTU pH = 7.4 S.U. EC = 1,900 μS	Chemical Dose (mg/L) = Temperature (^{0}C) =	105 9.6-10.8	32 9.5-10.4	2.75 9.5-10.1
3/10/05 Run 20	- Snowmelt - 100% On-Site Basin	Turb = 1,764 NTU pH = 7.3 S.U. EC = 3,022 μS	Chemical Dose (mg/L) = Temperature (^{0}C) =	290 5.6-7.6	240 5.5-7.6	9.82 5.6-7.7
3/19/05 Run 21	- Rain Event - 40% HY-89 + 40% Al Tahoe + 20% Ski Run	Turb = 256 NTU pH = 7.4 S.U. EC = 636 μS	Chemical Dose (mg/L) = Temperature (^{0}C) =	92 7.3-8.6	100 7.3-8.0	0.35 7.4-8.4
4/21/05 Run 22	- Snowmelt - 100% On-Site Basin	Turb = 408 NTU pH = 7.5 S.U. EC = 3,616 μS	Chemical Dose (mg/L) = Temperature (^{0}C) =	125 13.7-14.0	174 13.5-14.0	3.96 14.3-14.7
4/27/05 Run 23	- Rain Event - 100% HY-89	Turb = 316 NTU pH = 7.4 S.U. EC = 556 μS	Chemical Dose (mg/L) = Temperature (^{0}C) =	247 14.5-15.0	201 15.0-15.5	0.99 11.4-12.2

Chapter 5

Project Results

Chapter 5 Project Results

Presented in this chapter are the results and discussion for each of the treatment systems and/or experiments evaluated or conducted in Phase IV. A summary of data quality is presented first, followed by the results of the 4-inch extended run filter columns, jar test results, and lastly, the results of the chemically-enhanced sedimentation experiments. Results are typically evaluated with respect to the discharge limits due to come into effect within the Tahoe Basin.

5.1 Data Quality

Field and laboratory data were reviewed using procedures established in the Caltrans Comprehensive Protocols Guidance Manual (Caltrans, 2003d) and the Caltrans Guidance Manual, Storm Water Monitoring Protocols (Caltrans, 2000). The data also were evaluated with respect to the data quality objectives (DQOs) set forth in the Monitoring and Operations Plan (Caltrans, 2005). Specific quality control (QC) review criteria used are presented in Appendix A of this report. Data QC review included the evaluation of the following components:

1. Data completeness
2. Compliance with specified analytical methods
3. Analyte quantification/reporting limits
4. Holding time and sample preservation
5. Laboratory control samples (LCS, MS/MSD)
6. Total/dissolved comparison
7. Field blanks
8. Field duplicates
9. Performance evaluation samples

Data failing to meet the required quality objectives were issued a qualifier and reason code preceding entry into the database (see Section 5.1.10). A summary QC assessment of the data is presented in the following sections.

5.1.1 Data Completeness

"Completeness" is a statistic that assesses the percent of the data that was originally intended to be collected (as specified in the M&O Plan) compared to what was actually obtained. Each sample submitted to the laboratory typically required analysis of multiple constituents (i.e., Phos-T, Phos-D, TKN-T, TKN-D, TSS, etc.). Samples can be lost in transport (breakage or leakage), missed by the laboratory or not collected by project personnel. Sample completeness is calculated as the total number of determinations recorded divided by the number intended, expressed as a percent. Altogether, 55 of 6,412 individual data points (field and laboratory) were missed. For Phase IV, the overall data completeness was:

$$Sample\ Completeness = \frac{Data\ Recorded}{Data\ Intended}\ x\ 100 = \frac{6{,}412}{6{,}467}\ x\ 100 = 99.1\%$$

This result exceeds the 95 percent DQO set forth in the M&O Plan. No samples were lost, missed, or otherwise not reported by the analytical laboratory. Five samples, totaling 55 separate determinations, were not collected during the 6 months of pilot plant operation due to oversight. Listed in Table 5-1 are the samples missed (not collected) during Phase IV operation.

Table 5-1. Missing Samples (Samples Not Collected)

System or Experiment	Sample	Analysis Requested[a]	Number of Determinations Missed
4-Inch Filters	Run 19 Initial Clarifier Duplicate	Al (AS, T, D), Fe (T, D), Alk, Phos (T&D), TKN (T&D), TSS, NO_3, Turb, EC, Temp, pH	17
4-Inch Filters	Run 21 Initial Clarifier and Duplicate	Al (AS, T, D), Fe (T, D), Alk, Phos (T&D), TKN (T&D), TSS, NO_3,Turb, EC, Temp, pH	34
Jar Test	Run 22 Influent Duplicate	Phos-T, Phos-D	2
4-Inch Filters	Run 24 Interface Bottle Blank	Phos-T, Phos-D	2
		Total	**55**

[a] Abbreviations used, see Table 3-2

Interpretation of project results was not compromised by the missing samples because other samples collected at (or nearly at) the same time allow for an adequate characterization or estimation of the system, blank or replicate conditions.

"Data Validity", another assessment of the overall completeness of a data set, is the percentage of total samples (or determinations) for which results are found to be valid (i.e., non-qualified following quality control assessments). Reasons that lead to a particular data point to be qualified (codes preceding the entry in the database, see Section 5.1.10) include blank contamination, poor agreement between replicates, holding time violations, etc. In Phase IV, 104 of the 6,412 data values were qualified (1.6 percent). Validity was calculated as:

$$\text{Data Validity} = \frac{\text{All Data - Qualified Data}}{\text{All Data}} \times 100 = \frac{6{,}310}{6{,}412} \times 100 = 98.4\%$$

In Phase IV, 98 percent of the project data are considered valid and able to be used without any qualification. This statistic exceeds the 95 percent DQO set forth in the project M&O Plan.

5.1.2 Laboratory Compliance with Specified Analytical Methodology

Analytical methods requested for project determinations were outlined in the project M&O Plan and printed on all sample chain-of-custody forms. Methods specified were consistent with those presented in the Caltrans Comprehensive Protocols Guidance Manual (Caltrans, 2003d). All of the determinations conducted by the laboratory were by the methods specified.

5.1.3 Compliance with Specified Reporting Limits

Required project reporting limits specified in Table 3-1 of the M&O Plan (see Table 3-5 of this report) were furnished to the laboratory prior to the onset of the project. The required reporting limits were attained for all parameters with no exceptions.

5.1.4 Compliance with Sample Holding Times

Required project sample holding times were outlined in Table 3-1 of the M&O Plan and are summarized in Table 3-5 of this report. Required holding times are consistent with those specified in the Storm Water Monitoring Protocols (Caltrans, 2000) and accepted EPA protocols.

Early in the study, several coolers leaked ice water and were delayed by the shipper until rectified. As a result, 16 samples for TSS and 1 sample for VSS arrived at the laboratory too late for analysis within the 7-day holding time. Results of these samples, analyzed 1-3 days late, were issued the “J” (estimated) qualifier and the “a” reason code (holding time violation).

The DQO for holding time compliance set forth in the M&O Plan was 99.0 percent. Actual compliance with specified sample holding times was 99.7 percent, therefore exceeding the objective.

5.1.5 Laboratory Control Samples

The contract laboratory provided with each analytical report a summary of applicable internal QC sample activities. These activities include laboratory duplicates, method blanks, matrix spike/matrix spike duplicate (MS/MSD) and laboratory control samples (LCS) analyses. The required frequency of analyses and the DQO were established in the M&O Plan at the onset of the project. Laboratory reports were reviewed with respect to the DQO and found to be in compliance.

5.1.6 Total versus Dissolved Comparison

Laboratory results for constituents in which both total and dissolved measurements were collected were scrutinized for agreement. If the dissolved sample result exceeded the total result by more than the reporting limit (or 10 percent), the data were considered “estimated” and both results issued the “J” qualifier. If the dissolved sample result exceeded the total result by more than two times the reporting limit (or 20 percent), the data were “rejected” and both results were issued the “R” qualifier.

One pair of results were issued qualifiers due to poor agreement between total and dissolved results (sample 20-16E, 4-inch effluent from GFH column, Run 20, which had a total aluminum result = 119 μg/L and an acid soluble aluminum result of 221 μg/L, leading to rejection). For this sample, both the total and acid soluble aluminum results were issued the “R, c” qualifier proceeding entry in the database.

5.1.7 Field Blanks

Field blanks consist of the preparation and analysis of both bottle and equipment blanks. Bottle blanks allow verification that bottles obtained from the contract laboratory are clean and free from contamination. Additionally, bottle blanks can provide some insight as to the source of any contamination (i.e., inside or outside of the laboratory environment). Bottle blanks were prepared in the field by pouring de-ionized water directly into the sample bottles using "clean" techniques. Equipment blanks are used to determine if a contaminant is introduced during field sampling and processing (filtering, handling, splitting) or as an artifact of on-site decontamination (or lack thereof). Equipment blanks were prepared by rinsing randomly selected sample equipment (e.g., composite buckets, collection barrels) with de-ionized water and then processed like any other sample, including splitting and filtration. In most cases, blanks were sent to the laboratory with no markings indicating that the sample was a blank.

Experimental runs having blank contamination were evaluated according to United States Environmental Protection Agency (USEPA) and Caltrans guidelines (Caltrans, 2000). These guidelines establish the levels at which contamination requires qualification of the data. For sample results that are less than five times the blank concentration, the data are qualified as anomalous "U" (see Appendix A). After reviewing all data, qualifiers were added where necessary to the reported values in the database.

During Phase IV operations a total of 67 equipment blanks, having 274 associated determinations were prepared and shipped to the laboratory for analysis. Additionally, 54 separate bottle blanks having 252 associated determinations were prepared and sent to the laboratory. Results of the field blanks are summarized in Table 5-2. The category "# Hits" in Table 5-2 is the number of times that the analytical parameter was detected in the sample. The "percent" column lists the percent of the time a hit was recorded in the respective blank.

Of the 526 total field blank determinations, hits were reported 18 times (3.4 percent). As observed in Phase III, a slightly higher percentage of hits were reported in the bottle blanks than the field blanks (Table 5-2). Based on the criteria used for blank assessment (Appendix A), only a single value was qualified (bottle blank contamination, Run 23 Baker Tank TOC sample). Additional tables summarizing Phase IV blank samples collected can be found at the end of Appendix A.

5.1.8 Field Duplicates

Field duplicates are samples that are collected, processed and sent to the laboratory in replicate. Field duplicate samples are used to assess precision (i.e., variability attributed to collection, handling, shipment, storage, and/or laboratory processing). Procedures for collecting and processing field duplicates were the same as for normal (non-duplicate) samples. The acceptance (i.e., pass/fail) criterion was based on a calculated relative percent difference (RPD) of less than 50 percent (Caltrans, 2000). The RPD was calculated by dividing twice the difference between two measurements by the sum of the two measurements and multiplying by 100.

Table 5-2. Summary of Phase IV Field Blanks

Parameter	Equipment Blanks			Bottle Blanks		
	Number Collected	# Hits	Percent	Number Collected	# Hits	Percent
Aluminum - acid soluble	14	0	0	14	0	0
Aluminum - total	14	0	0	14	0	0
Aluminum - dissolved	14	0	0	14	0	0
Alkalinity - total	14	0	0	14	1	7.1
Phosphorus - dissolved	67	0	0	54	0	0
Kjeldahl Nitrogen - total	14	1	7.1	14	2	14.3
Kjeldahl Nitrogen - dissolved	14	0	0	14	0	0
Phosphorus - total	67	4	6.0	54	5	9.3
Total Suspended Solids	14	1	7.1	14	2	14.3
Nitrate + Nitrite Nitrogen	14	0	0	14	0	0
Total Nitrogen (Calculated)	14	0	0	14	0	0
Iron – total	7	1	14.3	7	0	0
Iron - dissolved	7	0	0	7	0	0
Organic Carbon - total	0	0	0	4	1	25.0
Volatile Suspended Solids	0	0	0	0	0	0
Totals	**274**	**7**	**2.6**	**252**	**11**	**4.4**

A total of 94 duplicate samples were collected and sent to the laboratory alongside the routine samples. Generally, each sample required the analysis of more than one analyte. Altogether, these duplicate pairs comprised 409 individual determinations. One duplicate sample was collected for each set of samples. When the duplicate samples had poor agreement, the samples collected in that set were all qualified.

Agreement between replicate samples was generally good. Out of 3,820 project laboratory determinations, a total of 104 required data qualifiers due to poor duplicate precision (2.7 percent). A complete summary breakdown of laboratory duplicates is presented in Table A-6 of Appendix A. Total and dissolved Kjeldahl (TKN-T and TKN-D) nitrogen determinations had the highest number of data points qualified for poor duplicate agreement; a total of 28 of the 392 project TKN values (both T&D) were qualified due to duplicate imprecision (7.1 percent, issued the “J, g” qualifier). When the TKN-T value was issued a qualifier, so was the corresponding total nitrogen value (calculated). Two of the 16 TOC determinations made on the Baker Tank “influent” samples were qualified due to poor duplicate agreement. None of the 1,792 total and dissolved phosphorus determinations required qualification due to poor duplicate agreement.

5.1.9 Performance Evaluation Samples

Commercially prepared Performance Evaluation (PE) samples were purchased and sent to the contract laboratory. A single PE sample containing only nitrogen and phosphorus (critical project parameters) was sent to the laboratory "blind" alongside routine 4-inch column effluent samples in November 2004 during the first run. Results of the PE samples are summarized in Table 5-3. Results for the determination of total phosphorus and TKN were within acceptable limits; however, the first PE for nitrate nitrogen was not. A second sample was sent in April of 2005 and the results are within the accepted range provided.

Table 5-3. Summary of Performance Evaluation Sample Determinations

Parameter	Units	Reported	True Value[a]	Advisory Range[a]
Total Kjeldahl Nitrogen	mg-N/L	2.20	2.33	1.72 – 3.01
Total Phosphorus	mg-P/L	9.44	9.36	7.75 – 10.29
Nitrate Nitrogen # 1	mg-N/L	2.67	2.08	1.76 – 2.36
Nitrate Nitrogen # 2	mg-N/L	12.0	12.8	11.0 – 14.4

[a] Values and range provided by Ultra Scientific (certified reference material)

5.1.10 Data Qualifiers

After quality control analysis, qualifier codes were entered into the database to denote a data entry of suspect quality. The data qualifier codes used for this project are consistent with those presented in the Storm Water Monitoring Protocols (Caltrans, 2003d, and 2000).

The two primary data qualifiers issued were "U" and "J". The "U" qualifier signifies that the result should be considered to be below the quantitation level for that run (anomalous) and was issued to samples with blank contamination (one instance). The "J" qualifier indicates that the result should be considered approximate (or estimated) due to poor duplicate agreement or missed holding time. Project data qualifiers and reason code definitions are summarized in Table 5-4. Both qualifiers, letter (upper case) and reason codes (lower case) are listed in the database prior to the listed result (Appendices B, D and F). A summary of data qualifiers and reason codes issued in this phase are presented in Table 5-5, broken down by treatment unit or experiment.

A total of 54 of 3,932 laboratory determinations were issued the "J, g" qualifier and code due to imprecision in the field blanks. Ninety-seven samples were qualified due to bottle and equipment blank contamination and were issued the "U" qualifier and "k" or "m" (or "k, m") qualifier and reason code. The laboratory's lateness in processing samples accounted for many samples being issued the "J, a" qualifier and reason code.

5.1.11 Rejected Data

In Phase IV, only one pair of aluminum determinations was rejected due to the acid soluble fraction reported to be greater than the total determination (Section 5.1.6).

Table 5-4. Project Data Qualifiers and Reason Codes

DATA QUALIFIER DEFINITIONS (Caltrans, 2000)			
U	The material was analyzed for, but was not detected above the modified level of the associated blank value. The qualified value represents a reporting limit that may or may not be elevated due to blank contamination. Data with U qualifiers are often considered as "anomalous".	J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample. The identification of the analyte is acceptable, but quality assurance criteria indicate that the quantitative values may be outside the normal expected range of precision, i.e., the quantitative value is considered "estimated".
UJ	This is a combination of the U and J flags. The analyte is considered not present. The reported value is to be considered equal to estimate contract required reporting limit. The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.	R	The sample result is rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified. This flag denotes the failure of quality control criteria such that it cannot be determined if the analyte is present or absent from the sample.
REASON CODE DEFINITIONS (project specific)			
a	Holding time violation	k	Equipment blank contamination
c	Dissolved concentration > than total	m	Bottle blank contamination
e	Laboratory duplicate imprecision	o	Trip blank contamination
g	Field duplicate imprecision	q	Laboratory control sample recovery failure
i	Method blank contamination	t	Matrix spike/matrix spike duplicate recovery failure

Table 5-5. Summary of Phase IV Qualified Data

Data Qualifier	Reason Code	Number of Qualified Points			
		4-Inch Filters	Settling Tests	Jar Test	Totals
J	g	85	0	0	85
J	a	17	0	0	17
U	M	2	0	0	2
R	C	2	0	0	2
				Grand Total[a] =	**106**

[a] 106 of 3,820 laboratory determinations were issued qualifier (2.8%)

5.2 4-Inch Filter Column Results

Four-inch diameter filter columns were operated in Phase IV to evaluate the effects of long-term operation on filter media performance. As in Phase III, a flow-through clarifier provided a constant source of settled storm water to the columns. Eighteen columns containing nine different media were operated during the seven experimental runs, each using a different storm water. Run duration varied from four to eight days. Filter media evaluated included the existing activated alumina (Alcoa DD-2, 28x48 mesh) and F-105 sand columns used in Phase III (Columns 1-4), as well as new columns containing 28/48 mesh and 14/28 mesh activated alumina, Superior 30 sand, limestone, iron-modified activated alumina, granular ferric hydroxide and Bayoxide E-33, all in pairs. As described in Section 4.2.2, the filters were reconstructed and replaced at various times throughout the study. Presented in this section are the results obtained from the Phase IV operation of the 4-inch extended run filter columns.

5.2.1 Clarifier Effluent Quality

Storm water held in the outside Baker Tank was run through a flow-through clarifier (see Section 3.2.1) to reduce the loading of solids to the filter columns. During the planning phase, it was thought that some type of storm water pretreatment was required to maximize filter performance and extend the hydraulic lifetime. The flow through clarifier used was reasonably effective in solids and turbidity removal (discussed below) and as a result, lower strength storm water was loaded onto the filters than what might be expected in the roadside environment.

Each run, the clarifier was filled with raw storm water (from the Baker tank) and the supply pump engaged so that the effluent was at equilibrium the day the filter columns were started. Clarifier effluent samples were collected on the first and last day of column operation. Initial and final values were averaged to calculate the loading to the 4-inch filter columns for each run. Average clarifier effluent water quality for each run is shown in Table 5-6. Values summarized in Table 5-6 are averages of the initial and final samples and their associated duplicates. The exception is Run 21, in which the initial sample was not collected (see Section 5.1.1).

Experimental runs ranged from four to eight days in duration with the clarifier effluent water quality being reasonably consistent through the runs (Run 20 being the exception). Graphs of the daily Baker Tank and clarifier effluent turbidity values measured for each experimental run are presented in Figures C-1 through C-16 of Appendix C. Fluctuations in turbidity were generally less than 20 percent for any given day. Illustrated in Figure 5-1 is a plot of final effluent clarifier turbidity versus the initial effluent turbidity. As can be seen in Figure 5-1, the final clarifier turbidity is very nearly equal to the initial (data points falling on the 45-degree line of equal influent and effluent NTU). The snowmelt water used during Experimental Run 20 was collected from the on-site basin and became appreciably less settleable over time (as evidenced from the daily settling rate measurements). This was the only storm water used that the settling characteristics shifted appreciably; however, averaging the initial and final samples likely provides a reasonably good estimation of loading to the 4-inch filter columns.

A graph of final clarifier effluent TSS concentration versus initial concentration is presented in Figure 5-2. Similar plots for total phosphorus and total Kjeldahl nitrogen (total) are shown in Figures 5-3 and 5-4, respectively. Again, with the exception of Run 20, the initial and final concentrations were relatively constant through any given experimental run.

Average removal percentages (n = 7) in the clarifier are presented in Table 5-7. Approximately 40 percent of the turbidity and 61 percent of the solids were removed during clarification. These percentages were up slightly from Phase III observations, which generally utilized lower strength (lower turbidity and TSS concentrations) snowmelt water as the feed water. Approximately 30 percent of the total phosphorus was removed in the clarifier. Total Kjeldahl nitrogen (TKN) percent reduction was -422 percent (from 0.27 to 1.41 mg-N/L) in Run 21 and -54 percent in Run 23 (0.57 to 0.88 mg-N/L). Without these two observations, TKN reduction was approximately 40 percent in the other five experimental runs.

Table 5-6. Phase IV Average Clarifier Effluent Water Quality (4-Inch Column Influent WQ)

Parameter	Units	Min.	Max.	Avg.	RUN 18	RUN 19	RUN 20	RUN 21	RUN 22	RUN 23	RUN 24
Flow Started	(date)	-	-	-	11-Dec-04	19-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
Sampled	(date)	-	-	-	13-Dec-04	21-Dec-04	12-Mar-05	23-Mar-05	23-Apr-05	1-May-05	15-May-05
Event Type	-	-	-	-	Rain	Rain	Snowmelt	Rain	Snowmelt	Rain	Rain/Melt
Water Source	-	-	-	-	HY89+ Ski Run	On-Site	On-Site	HY89+ Ski Run +	On-Site	HY 89	On-Site
pH (field)	S.U.	7.1	8.2	7.5	7.1	7.5	7.6	7.6	7.4	7.7	8.2
EC (field)	µS	434	3,640	1,759	2,059	1,895	3,021	639	3,640	623	434
Turb (field)	NTU	106	627	325	106	591	627	156	266	198	330
Temp (field)	°C	8.3	13.8	11.3	13.3	10.7	10.3	8.3	11.1	11.6	13.8
Al - AS	µg/L	76	1,088	360	200	1,088	209	669	76	154	124
Al - T	µg/L	1,360	10,458	5,083	1,360	6,827	10,458	2,861	4,778	3,530	5,766
Fe - T	µg/L	1,995	15,775	7,660	1,995	12,750	15,775	3,340	7,008	5,165	7,588
Al - D	µg/L	<25	27	<25	<25	<25	<25	<25	<25	27	<25
Fe - D	µg/L	32	388	112	54	36	388	77	38	157	32
Alk - T	mg-$CaCO_3$/L	18	58	33	28	25	39	36	30	58	18
Phos - D	mg-P/L	<0.03	0.32	0.12	<0.03	<0.03	0.04	<0.03	0.14	0.28	0.32
TKN - T	mg-N/L	0.37	1.70	1.05	1.11	1.70	1.15	1.41	0.74	0.88	0.37
TKN - D	mg-N/L	0.27	0.57	0.30	0.47	0.57	0.27	<0.1	0.29	0.38	<0.1
Phos - T	mg-P/L	0.10	0.58	0.35	0.10	0.24	0.58	0.30	0.32	0.34	0.55
TSS	mg/L	44	280	158	44	272	280	85	134	128	162
NO3	mg-N/L	<0.10	0.12	<0.10	0.12	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Tot - N	mg-N/L	0.37	1.70	1.07	1.23	1.70	1.15	1.41	0.74	0.88	0.37

NOTES:

Parameter abbreviations are listed in Table 3-2; Results listed are the average of the initial and final clarifier samples

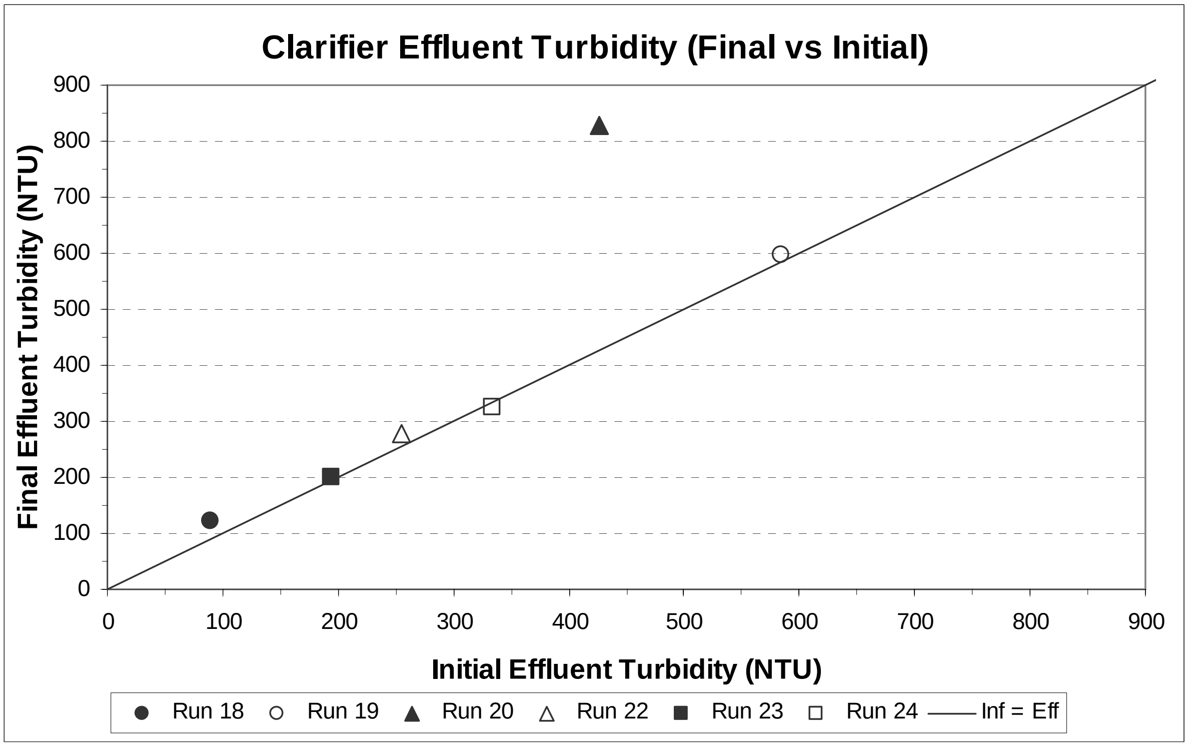


Figure 5-1. Clarifier Effluent Turbidity Final versus Initial Values

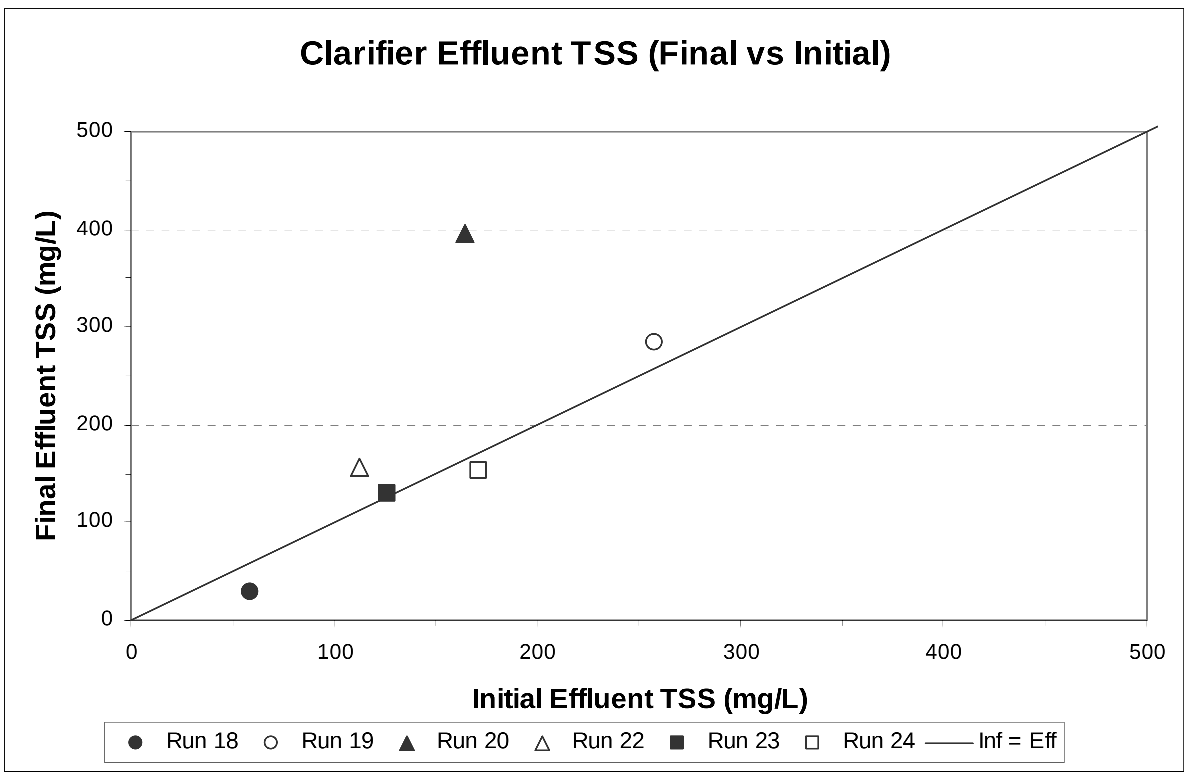


Figure 5-2. Clarifier Effluent TSS Final versus Initial Concentration

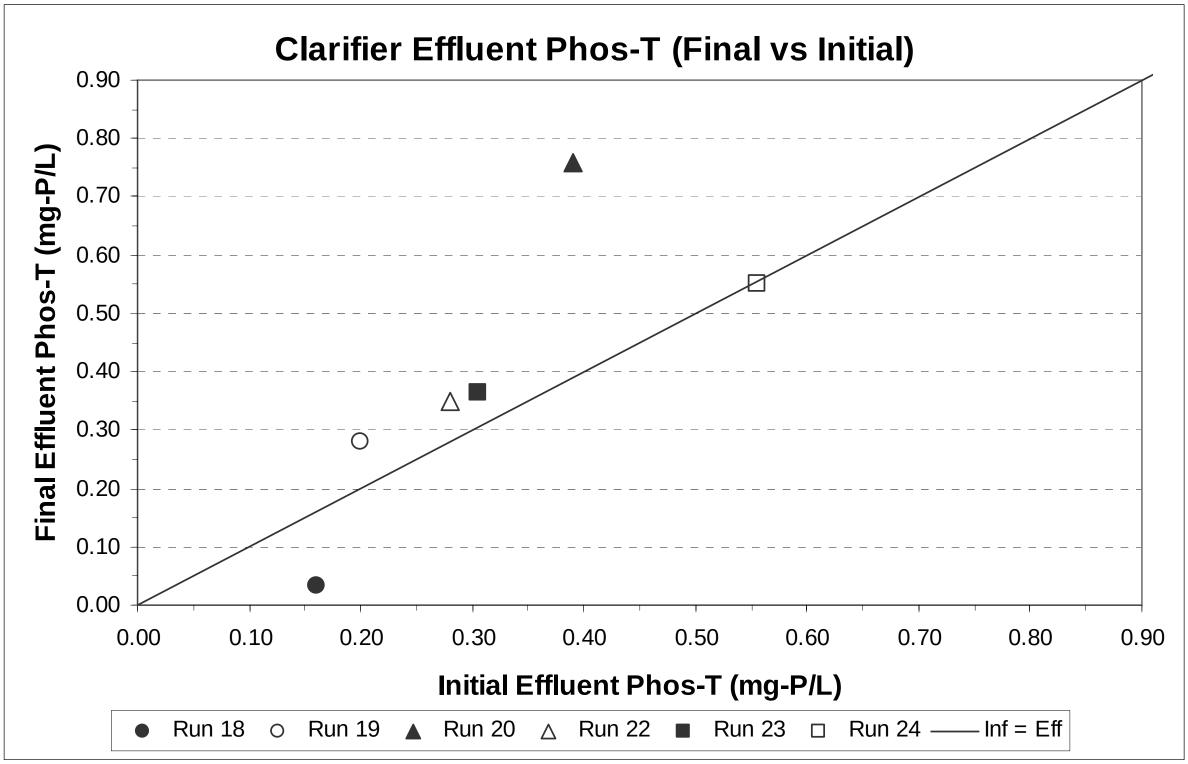


Figure 5-3. Clarifier Effluent Total Phosphorus Final versus Initial Concentration

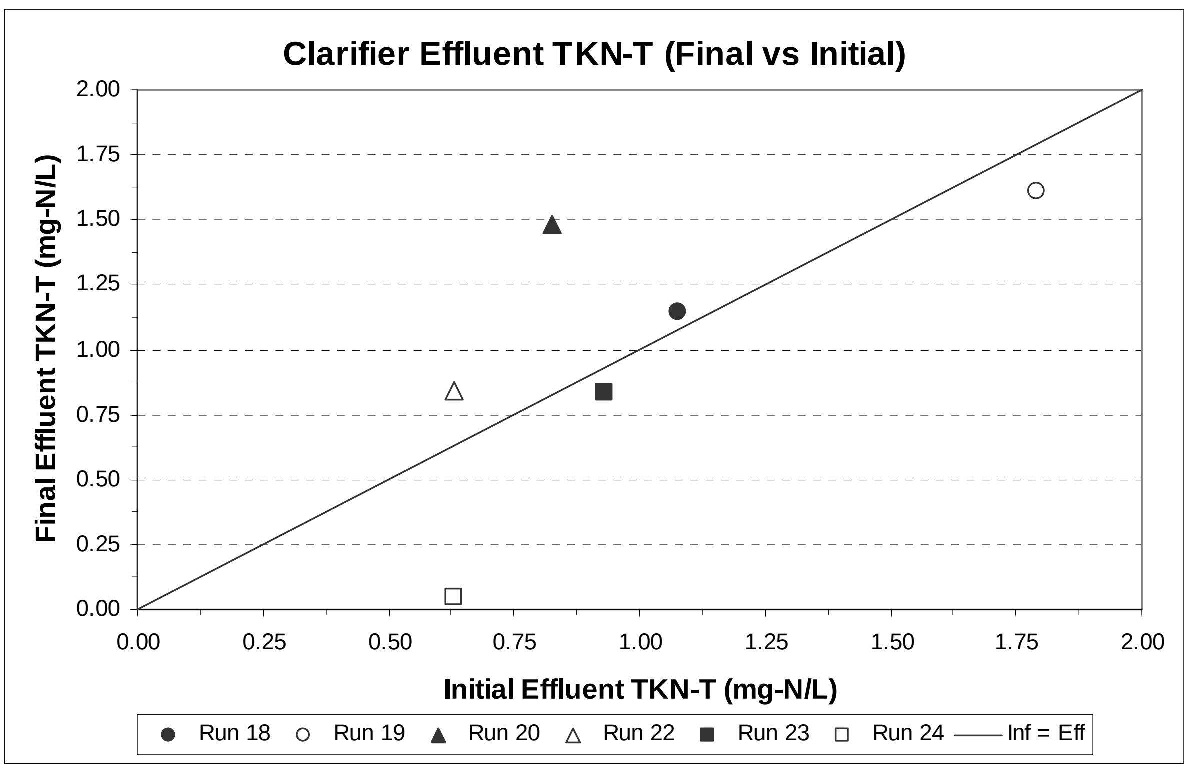


Figure 5-4. Clarifier Effluent TKN-Total Ending Versus Beginning Concentration

Table 5-7. Average Percent Removal in the Flow-through Clarifier

Parameter	Average Percent Removal in the Clarifier	
	Phase IV	Phase III
Turbidity	39.0	32.0
Total Suspended Solids	60.6	47.8
Phosphorus – Total	37.0	20.3
Total Kjeldahl Nitrogen (Total)	-43.9	18.1

5.2.2 Column Flow Rate, Loading and Hydraulics

The 4-inch filter columns were loaded with settled storm water at target flow rate of 20.6 mL/min (7.84 gallons per day, gpd) using peristaltic pumps as previously described. At this flow rate, approximately 12.0 ft (3.66 m) per day of storm water was applied to each filter. The 4-inch filters have a surface area of 0.087 ft^2 (81.1 cm^2), therefore the surface loading rate was 0.062 gpm/ft^2 (2.54 Lpm/m^2) at the target flow rate.

Actual measured flow rates and calculated loadings are shown in Table 5-8. The average seven-run, 18-column flow rate was 20.4 mL/min, which is only slightly below the target of 20.6 mL/min. The lowest average (weekly) flow rate delivered to any one column during the study was 19.6 mL/min (Column 17, Experimental Run 20). The highest average flow rate recorded was 21.3 mL/min to Column 6 during Experimental Run 19. During Phase IV, the "average column" was loaded with 11.89 ft (3.62 m) of settled storm water per day, with a range between 11.42 ft (3.48 m) and 12.41 ft (3.78 m). Flow rate records and additional column loading rates are included in Table B-1 of Appendix B.

Table 5-8. Target and Actual Flow and Loading Rate to the 4-Inch Filters

Flow Rate, Loading or Application	Target	This Study		
		Average	Low	High
mL/min	20.6	20.4	19.6	21.3
Gpd	7.84	7.76	7.46	8.10
ft/d	12.00	11.89	11.42	12.41
m/d	3.66	3.62	3.48	3.78
gpm/ft^2	0.062	0.062	0.059	0.064
Lpm/m^2	2.54	2.52	2.42	2.63

Total volume filtered by each column during each run, in liters, is shown in Table 5-9. Similarly, the total linear feet (depth of water over filter area) filtered by each column is presented in Table 5-10. All columns were operated for all seven experimental runs; however, some columns were out of service for several hours or days (see Table 4-4). Experimental Run 18 was eight days in duration, with the columns filtering an average of 234 L each (61.8 gal, equivalent to 95 ft depth over the filter area). Experimental Run 19 was four days long, with the columns filtering an average of 117 L (30.9 gal, equivalent to 47 ft over filter area). Over the seven experimental runs, the “average filter” processed 1,247 L (329 gal, equivalent to 515 linear feet) of storm water. Column 14, containing iron-modified activated alumina filtered 1,167 L (308 gal, equivalent to 472 ft) because it was out of service for several days, and ultimately returned into service with only 12 inches of media. Column 12, containing limestone, filtered 1,331 L (352 gal, equivalent to 539 ft) during the seven runs. Additional volume filtered information can be found in Table B-1 in Appendix B.

Table 5-9. Volume of Storm Water Filtered During Phase IV

	Volume Filtered (in Liters)							
Exp. Run	18	19	20	21	22	23	24	Total
Column								
Col 1 (old 28x48 AA)	234	109	146	177	208	203	145	1,220
Col 2 (old 28x48 AA)	238	120	160	172	203	201	159	1,253
Col 3 (F-105 Sand)	234	105	175	175	204	205	206	1,304
Col 4 (F-105 Sand)	226	122	177	173	207	203	206	1,313
Col 5 (28x48 AA)	234	123	171	174	205	204	153	1,263
Col 6 (28x48 AA)	238	112	175	171	207	204	155	1,261
Col 7 (14x28 AA)	237	122	177	171	206	204	181	1,298
Col 8 (14x28 AA)	233	120	176	175	210	207	203	1,323
Col 9 (Superior 30)	236	121	170	177	211	204	204	1,322
Col 10 (Superior 30)	231	122	174	180	208	203	204	1,322
Col 11 (Limestone)	236	119	178	175	210	206	207	1,330
Col 12 (Limestone)	233	123	174	180	207	205	209	1,331
Col 13 (Fe-Mod. AA)	233	105	158	149	112	207	207	1,171
Col 14 (Fe-Mod. AA)	234	123	162	135	99	206	207	1,167
Col 15 (GFH)	234	117	175	163	201	207	132	1,229
Col 16 (GFH)	231	121	174	173	202	205	146	1,251
Col 17 (Bayoxide)	237	109	170	173	205	206	159	1,258
Col 18 (Bayoxide)	230	121	174	176	200	208	197	1,307

Column hydraulics were monitored each run by recording the height of standing water above the sand cap surface and noting any instances of discharge via the overflow outlet. When a column failed hydraulically (discharge via the overflow outlet) the column was removed from service and reconstructed by replacing the sand cap and sometimes the top portion of the media (see M&O Plan for a more complete description of activities used to maintain flow). Along with overflow, access ports at the sand/media interface were also used to assess the hydraulic condition of filter and sand cap. In some instances, when water flowed freely from the sand cap, the surface media layer was replaced without first trying to simply replace the sand cap. The depth of media to remove in order to restore flow was determined from visual assessment and texture of the upper layer. Usually, the media layer identified as responsible for flow occlusion was removed, and no more. In several instances, the following day, additional media was excavated and replaced because the first servicing was not adequate to restore flow. Service performed on the columns and the date the activity occurred are summarized in Section 4.2.2. A complete record of head measurements can be found in Appendix B. Diagrams of head versus time for each of the filter columns are shown in Figures C-17 through C-34 in Appendix C. In the following sections, the hydraulic performance of each of the media (column pairs) is briefly discussed.

Table 5-10. Linear Feet (Depth Over Filter Area) of Storm Water Filtered During Phase IV

	Linear Feet (ft) Filtered							
Exp. Run	18	19	20	21	22	23	24	Total
Column								
Col 1 (old 28x48 AA)	94.5	44.0	58.9	71.6	84.0	82.3	58.5	494
Col 2 (old 28x48 AA)	96.2	48.4	64.9	69.6	82.3	81.4	64.4	507
Col 3 (F-105 Sand)	94.5	42.3	70.8	70.9	82.7	83.1	83.2	528
Col 4 (F-105 Sand)	91.3	49.2	71.5	69.8	83.9	82.3	83.3	531
Col 5 (28x48 AA)	94.7	49.6	69.2	70.3	82.8	82.7	61.8	511
Col 6 (28x48 AA)	96.2	45.4	70.7	69.0	83.7	82.6	62.8	510
Col 7 (14x28 AA)	95.7	49.4	71.4	69.2	83.5	82.4	73.4	525
Col 8 (14x28 AA)	94.1	48.6	71.2	70.9	84.9	83.7	82.1	535
Col 9 (Superior 30)	95.4	48.8	68.7	71.7	85.3	82.6	82.4	535
Col 10 (Superior 30)	93.4	49.5	70.3	73.0	84.1	82.0	82.7	535
Col 11 (Limestone)	95.4	48.3	72.0	70.8	84.8	83.2	83.6	538
Col 12 (Limestone)	94.3	49.7	70.4	72.6	83.9	82.9	84.7	539
Col 13 (Fe-Mod. AA)	94.4	42.3	63.9	60.2	45.5	83.8	83.7	474
Col 14 (Fe-Mod. AA)	94.8	49.9	65.7	54.6	40.2	83.3	83.8	472
Col 15 (GFH)	94.6	47.3	70.9	65.9	81.3	83.9	53.5	497
Col 16 (GFH)	93.4	48.8	70.5	70.1	81.7	83.0	58.9	506
Col 17 (Bayoxide)	95.8	44.1	68.8	70.1	82.8	83.2	64.4	509
Col 18 (Bayoxide)	93.1	49.0	70.6	71.2	80.9	84.1	79.9	529

Existing Activated Alumina

Columns 1 and 2 contained 28x48 mesh Alcoa DD-2 activated alumina used in both Phase III and Phase IV. Columns 1 and 2 filtered 494 and 507 ft of storm water in Phase IV, 598 and 584 ft in Phase III, for a total of 1,092 and 1,091 feet, respectively. Assuming the annual Tahoe Basin rainfall is 30 inches and applying expected Caltrans filter design assumptions (30 Water Quality Volumes [WQV]/yr, 2 ft/day media permeability, 1 day drawdown, load/filter area = 3 ft.) the annual expected "Tahoe" filter load is approximately 90 feet. At this annual hydraulic loading, Columns 1 and 2 filtered approximately 5.5 and 5.6 years worth of storm water during Phase IV, 6.6 and 6.5 years in Phase III, respectively, for a total of 12.1 years of annual hydraulic simulation (per filter).

Both columns, however, required considerable effort to maintain flow as both columns were prone to frequent hydraulic failure (overflow, >42" of head). A graph of head versus time (cumulative run days) for Column 1 is shown in Figure C-17 (Appendix C) and the graph for Column 2 is presented in Figure C-18. Because the first day (day zero) was included for some runs to facilitate spacing, the x-axis is not strictly correct with respect to the true cumulative run days (columns were operated for 46, 24-hour days). Column servicing activities, head and turbidity are positioned on a similar axis.

Summarized in Table 5-11 are the activities required to maintain flow, the linear feet filtered at the time of failure and the years of simulated service based on the 90 ft/year Tahoe Basin hydraulic load. The date of failure listed in Table 5-11 is in the format of experimental run number followed by the day into the run. Experimental Run numbers 1-12 were in Phase III.

Table 5-11. 4-Inch Column Maintenance Activity and Storm Water Filtered at Failure for Columns 1 & 2, Existing Activated Alumina (28x48)

Col.	Activity at Failure	Failure Date (Run-Day)	Linear Feet (ft) Filtered at Failure	Years of "Tahoe" Equivalent Load Between Failures
1	Sand Cap Replaced	3-5	142	1.6
1	1" Media + Sand Cap Replaced	8-5	259	2.9
1	Sand Cap Replaced	11-5	142	1.6
1	Sand Cap Replaced	18-5	59	0.7
1	Sand Cap Replaced	19-1	42	0.5
1	2" Media + Sand Cap Replaced	20-1	44	0.5
1	6" Media + Sand Cap Replaced	20-3	16	0.2
1	Sand Cap Replaced	22-3	144	1.6
1	Sand Cap Replaced	24-1	136	1.5
1	1" Media + Sand Cap Replaced	24-2	7	0.1
1	Sand Cap Replaced	24-4	10	0.1
2	Sand Cap Replaced	3-5	130	1.4
2	1" Media + Sand Cap Replaced	8-5	254	2.8
2	Sand Cap Replaced	11-5	143	1.6
2	Sand Cap Replaced	18-5	59	0.7
2	Sand Cap Replaced	19-1	42	0.5
2	2" Media + Sand Cap Replaced	20-1	44	0.5
2	6" Media + Sand Cap Replaced	20-3	16	0.2
2	Sand Cap Replaced	22-3	144	1.6
2	Sand Cap Replaced	24-1	136	1.5
2	1" Media + Sand Cap Replaced	24-2	7	0.1
2	Sand Cap Replaced	24-4	10	0.1
	Average Between Sand Cap Replacement		90.3	1.0
	Average Between Media + Cap Replacement		287	3.2

Experimental Run numbers 18-24 were in Phase IV. Column 1 required replacing the sand cap two times in Phase III and five times in Phase IV. Some portion of the media in Column 1 was replaced once in Phase III and three times in Phase IV. Similarly, Column 2 required replacing the sand cap two times in Phase III and five times in Phase IV and cap + media once in Phase III and three times in Phase IV. The average amount of storm water filtered by these columns between sand cap replacements was 90 feet, or about one year simulated service in the Tahoe area. The average amount of storm water filtered between sand cap + media replacement was 287 feet, or about 3.1 years of simulated operation. Altogether in Phase IV, the existing activated alumina required a combined total of 16 interventions (sand cap or sand cap + media replacements) to restore flow.

F-105 Sand

Columns 3 and 4 contained the same fine sand media (F-105 Filter Sand) used in Phase III. Columns 3 and 4 filtered 528 and 531 ft of storm water in Phase IV, 602 and 604 ft in Phase III, for a total of 1,130 and 1,135 feet, respectively. At the Tahoe Basin annual hydraulic loading rate of 90 ft/yr, both columns filtered approximately 5.9 years worth of storm water during Phase IV, 6.7 years in Phase III, for a total simulated hydraulic load of 12.6 years (each column).

The F-105 sand columns required relatively little intervention to maintain flow. Graphs of head versus time for Columns 3 and 4 are shown in Figures C-20 and C-21 (Appendix C). Summarized in Table 5-12 are the activities required to maintain flow, the linear feet filtered at the time of failure and the years of simulated service. Again, the date of failure listed in Table 5-12 is in the format of experimental run number followed by the day into the run, with Experimental Run Numbers 1-12 from Phase III and 18-24 from Phase IV. Both Column 3 and Column 4 required replacement of the sand cap three times in Phase III and two-three times in Phase IV. Neither column required media replacement. The average amount of storm water filtered between sand cap replacements was 163 feet, or about 1.8 years of simulated operation. Altogether in Phase IV, the existing F-105 sand required a combined total of five interventions.

Activated Alumina (28x48)

Columns 5 and 6 were filled with new 28x48 mesh Alcoa DD-2 activated alumina. Columns 5 and 6 filtered 511 ft and 510 ft of storm water during Phase IV, respectively. In Phase IV, at the Tahoe Basin annual loading rate of 90 ft/yr, these columns both filtered approximately 5.7 years of simulated flow.

As with the existing DD-2 activated alumina used in Columns 1 and 2, the new DD-2 (same mesh) required considerable intervention to maintain flow. Graphs of head versus time for Columns 5 and 6 are shown in Figures C-21 and C-22 respectively. Summarized in Table 5-13 are the activities required to maintain flow, the linear feet filtered at the time of failure and the years of simulated service. For the first six runs, replacing the sand cap restored flow through the filter column. Replacement of the upper layer of media was not necessary until the last experimental run (Run 24). Both Column 5 and Column 6 required replacement of the sand cap four times and cap + media one-two times. Column 5 had the flow restored in Experimental Run 24 with the replacement of 1 inch of media. Column 6 required the replacement of 3 inches. The average amount of storm water filtered between sand cap replacements was 88 feet, or about 1.1 years of simulated operation (approximately the same as for the old, existing DD-2 used in Columns 1 & 2); however, the average length of time between cap + media replacement increased from 3.2 years for the old media to 5.3 years for the new media. Collectively, the new 28x48 mesh DD-2 filters required a combined total of 11 interventions in Phase IV.

Table 5-12. 4-Inch Column Maintenance Activity and Storm Water Filtered at Failure for Columns 3 and 4, Existing F-105 Sand

Col.	Activity at Failure	Failure Date (Run-Day)	Linear Feet (ft) Filtered at Failure	Years of "Tahoe" Equivalent Load Between Failures
3	Sand Cap Replaced	3-5	164	1.8
3	Sand Cap Replaced	9-5	303	3.4
3	Sand Cap Replaced	11-5	79	0.9
3	Sand Cap Replaced	19-1	100	1.1
3	Sand Cap Replaced	22-5	238	2.6
4	Sand Cap Replaced	3-5	169	1.9
4	Sand Cap Replaced	9-5	307	3.4
4	Sand Cap Replaced	11-5	70	0.8
4	Sand Cap Replaced	18-6	67	0.7
4	Sand Cap Replaced	19-2	46	0.5
4	Sand Cap Replaced	23-0	252	2.8
	Average Between Sand Cap Replacement		163	1.8

Table 5-13. 4-Inch Column Maintenance Activity and Storm Water Filtered at Failure for Columns 5 and 6, Activated Alumina (28x48)

Col.	Activity at Failure	Failure Date (Run-Day)	Linear Feet (ft) Filtered at Failure	Years of "Tahoe" Equivalent Between Failures
5	Sand Cap Replaced	19-0	95	1.1
5	Sand Cap Replaced	20.5	107	1.2
5	Sand Cap Replaced	22-1	94	1.0
5	Sand Cap Replaced	24-1	161	1.8
5	1" Media + Sand Cap Replaced	24-4	19	0.2
6	Sand Cap Replaced	19-1	103	1.2
6	Sand Cap Replaced	21-3	144	1.6
6	Sand Cap Replaced	22-5	95	1.1
6	Sand Cap Replaced	24-1	117	1.3
6	1" Media + Sand Cap Replaced	24-4	17	0.2
6	3" Media + Sand Cap Replaced	24-5	12	0.1
	Average Between Sand Cap Replacement		95	1.1
	Average Between Media + Cap Replacement		476	5.3

Activated Alumina (14x28)

Columns 7 and 8 were filled with new 14x28 mesh Alcoa DD-2 activated alumina, which is visibly more coarse than the 28x48 mesh used in Columns 5 and 6. Columns 7 and 8 filtered 525 and 535 ft of storm water during Phase IV, respectively. In Phase IV, at the Tahoe Basin annual loading rate of 90 ft/yr, these columns both filtered approximately 5.9 years of simulated flow.

This coarser mesh material required considerably less intervention to maintain flow through the filter beds than the finer 28x48 DD-2 material. Graphs of head versus time for the two columns are shown in Figures C-23 and C-24 of Appendix C. Activities required to maintain flow, and the feet filtered at the time of failure are listed in Table 5-14. Column 7 required replacement of the sand cap three times and Column 8 only two times. Neither column required media replacement. The average amount of storm water filtered between sand cap replacements was 165 feet, or about 1.8 years of simulated operation. Collectively in Phase IV, the coarser DD-2 media required a combined total of five interventions.

Superior 30 Sand

Columns 9 and 10 contained Superior 30 sand and both filtered 535 feet of settled storm water during Phase IV. With respect to the expected Tahoe Basin annual load (90 ft), both columns filtered approximately 5.9 years of simulated flow.

Table 5-14. 4-Inch Column Maintenance Activity and Storm Water Filtered at Failure for Columns 7 and 8, Activated Alumina (14x28)

Col.	Activity at Failure	Failure Date (Run-Day)	Linear Feet (ft) Filtered at Failure	Years of "Tahoe" Equivalent Between Failures
7	Sand Cap Replaced	19-0	96	1.1
7	Sand Cap Replaced	21-3	155	1.7
7	Sand Cap Replaced	24-1	204	2.3
8	Sand Cap Replaced	19-2	118	1.3
8	Sand Cap Replaced	23-0	252	2.8
	Average Between Sand Cap Replacement		165	1.8

The Superior 30 sand required relatively little intervention to maintain flow; however, it still required three replacements of the sand cap per filter. Graphs of head versus time for these two columns are shown in Figures C-25 and C-26 of Appendix C. Activities required to maintain flow through the Superior 30 sand filters and the feet of storm water filtered at the time of failure are listed in Table 5-15. Both filter columns required replacement of the sand cap three times and neither required any excavation into the bed (also Superior 30 sand). From the data in Table 5-15, the average amount of storm water filtered between sand cap replacements was 101 feet, or about 1.1 years of simulated operation; however, another sand cap replacement was imminent towards the end of Run 24. Since the span between Run 22 and Run 24 is large, factoring another sand cap replacement at the end of Run 24 shifts the time between cap replacements from 1.1 to 1.5 years. Collectively in Phase IV, the Superior 30 sand media required a combined total of six interventions.

Table 5-15. 4-Inch Column Maintenance Activity and Storm Water Filtered at Failure for Columns 9 and 10, Superior 30 Sand

Col.	Activity at Failure	Failure Date Run-Day)	Linear Feet (ft) Filtered at Failure	Years of "Tahoe" Equivalent Between Failures
9	Sand Cap Replaced	18-6	72	0.8
9	Sand Cap Replaced	20-5	130	1.5
9	Sand Cap Replaced	22-3	119	1.3
10	Sand Cap Replaced	18-6	70	0.8
10	Sand Cap Replaced	20-5	132	1.5
10	Sand Cap Replaced	22-0	85	1.0
	Average Between Sand Cap Replacement		101	1.1

Limestone (#4 Sand)

Columns 11 and 12 contained limestone and each filtered approximately 538 feet of settled storm water during Phase IV. With respect to the expected Tahoe Basin annual load (90 ft), both of these columns filtered approximately 6.0 years of simulated flow.

The limestone filter columns required relatively little intervention to maintain flow. Column 11 required two sand cap replacements and Column 12 required three. Graphs of head versus time for the limestone filters are shown in Figures C-27 and C-28 of Appendix C. Activities required to maintain flow through the limestone filters and the feet of storm water filtered (at failure) are shown in Table 5-16. Neither filter column required any media replacement. From the data in Table 5-16, the average amount of storm water filtered between sand cap replacements was 127 feet, or about 1.4 years of simulated operation. Collectively in Phase IV, the limestone sand media required a combined total of five interventions.

Table 5-16. 4-Inch Column Maintenance Activity and Storm Water Filtered at Failure for Columns 11 and 12, Limestone Sand

Col.	Activity at Failure	Failure Date (Run-Day)	Linear Feet (ft) Filtered at Failure	Years of "Tahoe" Equivalent Between Failures
11	Sand Cap Replaced	19-0	95	1.1
11	Sand Cap Replaced	22-0	191	2.1
12	Sand Cap Replaced	19-0	94	1.1
12	Sand Cap Replaced	21-3	157	1.7
12	Sand Cap Replaced	22-5	96	1.1
	Average Between Sand Cap Replacement		127	1.4

Iron-Modified Activated Alumina

Columns 13 and 14 contained iron-modified activated alumina media and required the most intervention to maintain flow of any of the media evaluated. By replacing the sand cap and some of the surface media, the columns were able to operate from Run 18 through Run 22, filtering approximately 306 ft of storm water each (3.4 years of simulated flow). However, after the removal of 6 inches of media failed to restore flow, the upper 12 inches of media were removed and the columns operated with a bed depth of 12 inches for the last two experimental runs (filtering an additional 167 ft, or about 1.9 years of simulated operation).

Column 13 required three sand cap replacements and two cap + media replacements prior to removing 12 inches at the beginning of Run 23. Column 14 required four sand cap replacements and two cap + media replacements prior to Run 23. Graphs of head versus time for the iron-modified activated alumina filters are presented in Figures C-29 and C-30. Activities required to maintain the flow through the filters and the storm water filtered (at failure) are listed in Table 5-17.

Table 5-17. 4-Inch Column Maintenance Activity and Storm Water Filtered at Failure for Columns 13 and 14, Iron-modified Activated Alumina

Col.	Activity at Failure	Failure Date (Run-Day)	Linear Feet (ft) Filtered at Failure	Years of "Tahoe" Equivalent Between Failures
13	Sand Cap Replaced	19-1	100	1.1
13	Sand Cap Replaced	20-2	54	0.6
13	2" Media + Sand Cap Replaced	21-1	52	0.6
13	Sand Cap Replaced	22-1	63	0.7
13	6" Media + Sand Cap Replaced	22-3	21	0.2
13	12" Media Removed	23-0	16	0.2
14	Sand Cap Replaced	18-7	83	0.9
14	Sand Cap Replaced	20-2	81	0.9
14	Sand Cap Replaced	21-0	46	0.5
14	1" Media + Sand Cap Replaced	21-1	6	0.1
14	Sand Cap Replaced	22-1	55	0.6
14	6" Media + Sand Cap Replaced	22-3	18	0.2
14	12" Media Removed	23-0	15	0.2
	Average Between Sand Cap Replacement		50	0.6
	Average Between Media + Cap Replacement		290	3.2

From the data in Table 5-17, the average amount of storm water filtered between sand cap replacements was slightly less than 50 feet, or about 0.6 years of simulated operation. Based on the volume filtered between the first two cap + media replacements, each filter was able to process approximately 290 ft of storm water (3.2 years of simulated operation between media replacements); however, the second replacement of 6 inches of media was not successful in restoring flow. As a full 24-inch bed depth filter, the iron-modified activated alumina filters only lasted 70 percent of Phase IV, requiring a total of 13 interventions. For comparison purposes, normalizing this number to full operation in Phase IV, this media would have required a combined total of at least 19 interventions.

Granular Ferric Hydroxide

Columns 15 and 16 contained GFH media and required significant intervention to maintain flow. Column 15 filtered 497 ft (5.5 years) and Column 16 filtered a total of 506 ft, or about 5.6 years of simulated operation in the field.

Unlike Columns 13 and 14 (iron-modified activated alumina), flow was restored after the sand cap or cap + media was replaced. Both Columns 15 and 16 required four sand cap replacements and two cap + media replacements each. Graphs of head versus time for the GFH filters are presented in Figures C-31 and C-32. Activities required and the storm water filtered are listed in Table 5-18. The average amount of storm water filtered between sand cap replacements was approximately 78 feet, or about 0.9 years of simulated operation. The average time between sand cap + media replacements was 234 ft (approximately 2.6 years). Collectively the GFH media required a combined total of 12 interventions to maintain flow.

Table 5-18. 4-Inch Column Maintenance Activity and Storm Water Filtered at Failure for Columns 13 and 14, Granular Ferric Hydroxide

Col.	Activity at Failure	Failure Date (Run-Day)	Linear Feet (ft) Filtered at Failure	Years of "Tahoe" Equivalent Between Failures
15	Sand Cap Replaced	18-5	59	0.7
15	Sand Cap Replaced	19-2	45	0.5
15	2" Media + Sand Cap Replaced	21-1	116	1.3
15	Sand Cap Replaced	22-5	117	1.3
15	Sand Cap Replaced	24-1	113	1.3
15	1" Media + Sand Cap Replaced	24-4	13	0.1
16	Sand Cap Replaced	18-5	59	0.7
16	Sand Cap Replaced	19-2	46	0.5
16	2" Media + Sand Cap Replaced	21-1	119	1.3
16	Sand Cap Replaced	22-3	94	1.1
16	Sand Cap Replaced	24-1	137	1.5
16	1" Media + Sand Cap Replaced	24-4	16	0.2
	Average Between Sand Cap Replacement		78	0.9
	Average Between Media + Cap Replacement		234	2.6

Bayoxide E-33®

Columns 17 and 18 contained Bayoxide E-33 media and required a moderate amount of operator intervention to maintain flow. Column 17 filtered 509 ft (5.7 years) and Column 18 filtered 529 ft of settled storm water (5.9 years of simulated operation).

To maintain flow through the filter, Column 17 required a total of three sand cap replacements. For an unknown reason, Column 18 required more intervention than its counterpart. Column 18 required four sand cap replacements and one sand cap + 1 inch of media. Graphs of head versus time for the Bayoxide media filters are presented in Figures C-33 and C-34. Presented in Table 5-19 are the activities required to maintain flow and the amount of storm water filtered. The average amount of storm water filtered between sand cap replacements was approximately 118 feet, or about 1.3 years of simulated operation. The time between sand cap + media replacements (Column 18 only) was 293 ft (approximately 3.3 years). Collectively the GFH media required a combined total of eight interventions.

Media Hydraulic Performance Comparison

Comparing the hydraulic performance of the various filter media tested directly is difficult because of the variations in feed, the fact that some columns required media replacement, and two of the nine media were tested in both Phases III and IV. However, a rudimentary evaluation of the hydraulic performance of the filter media tested in Phase IV can be made by simply comparing the number of interventions (i.e. number of times the sand cap and cap + media were replaced) collectively required for the individual column pairs. Summarized in Table 5-20 are the number of interventions required to maintain flow throughout the study and the average amount of storm water filtered at sand cap replacement and at media and cap replacement.

Table 5-19. 4-Inch Column Maintenance Activity and Storm Water Filtered at Failure for Columns 13 and 14, Bayoxide E-33

Col.	Activity at Failure	Failure Date (Run-Day)	Linear Feet (ft) Filtered at Failure	Years of "Tahoe" Equivalent Between Failures
17	Sand Cap Replaced	19-1	96	1.1
17	Sand Cap Replaced	21-5	171	1.9
17	Sand Cap Replaced	24-1	184	2.0
18	Sand Cap Replaced	19-0	93	1.0
18	Sand Cap Replaced	21-1	132	1.5
18	Sand Cap Replaced	22-0	59	0.7
18	2" Media + Sand Cap Replaced	22-1	9	0.1
18	Sand Cap Replaced	24-1	164	0.2
	Average Between Sand Cap Replacement		118	1.3
	Average Between Media + Cap Replacement		293	3.3

Table 5-20. Hydraulic Summary of the Various 4-Inch Column Media (Phase IV)

Media	Number Interventions	At Sand Cap Replacement		At Cap + Media Replacement	
		Ft Filtered	# Years Hydraulic Load	Ft Filtered	# Years Hydraulic Load
Fe-Mod. AA	19 [a]	50	0.6	290	3.2
Existing AA [b]	16	90	1.0	287	3.2
GFH	12	78	0.9	234	2.6
AA (28x48)	11	95	1.1	476	5.3
Bayoxide E-33	8	118	1.3	293	3.3
Superior 30	6	101	1.1	>535	>5.9
Limestone	5	127	1.4	>530	>5.9
F-105 Sand [b]	5	163	1.8	>530	>5.9
AA (14x48)	5	165	1.8	>530	>5.9

[a] The number of interventions normalized to seven Phase IV experimental runs
[b] Phase IV data only

An evaluation of media solids (TSS) loading and contaminant removal is presented in subsequent sections of this chapter. However, with respect to the simple ability to pass water and not become occluded, the larger mesh (14x28) activated alumina media is the best, operating approximately 1.8 years of simulated operation between interventions. The existing activated alumina and the new material behaved similarly, both able to filter approximately 1.1 years of storm water. Hydraulically, the F-105 sand is superior to the finer grain sized Superior 30 sand. An analysis of the mass of solids loaded onto the filters at the time of failure is presented in Section 5.2.12.

5.2.3 Presentation of 4-Inch Column Water Quality Data

Effluent water quality data for the 4-inch filter columns are presented both graphically and numerically, as discussed below.

Graphical

Effluent water quality results are presented graphically in numerous figures in Appendix C of this report. The figures are a series of bar charts illustrating filter effluent concentrations for the various water quality parameters measured in Phase IV. There are a total of 10 separate graphs for each water quality parameter (one graph for each parameter by column pair), with the exception of total and dissolved iron, for which there are only six graphs each (iron was not measured on samples from columns 1-8). A graph of influent (Baker Tank) and clarifier effluent (4-inch column influent) data is the last graph for each water quality parameter.

Shown in these bar graphs are the effluent concentrations or values of the media columns alongside the influent (clarifier effluent) value. A typical graph is presented in Figure 5-5. Bars are grouped by Experimental Run. One effluent sample was collected from each column for each experimental run. Also shown on the bar charts are any interventions that occurred, such as sand cap or media replacements. If Tahoe Basin surface water discharge limits are applicable for the parameter in question, the limits are shown on the bar charts as a solid line (abbreviated as Reg Lmt in the legend). Also shown on the bar charts are the laboratory reporting limits (abbreviated as Rpt Lmt in the legend). In the event that a bar goes off scale, values are shown next to or above the bar. All samples were collected; therefore, if a bar is not visible, the analyte is present at the reporting limit (or at a low concentration) that is indistinguishable from the axis.

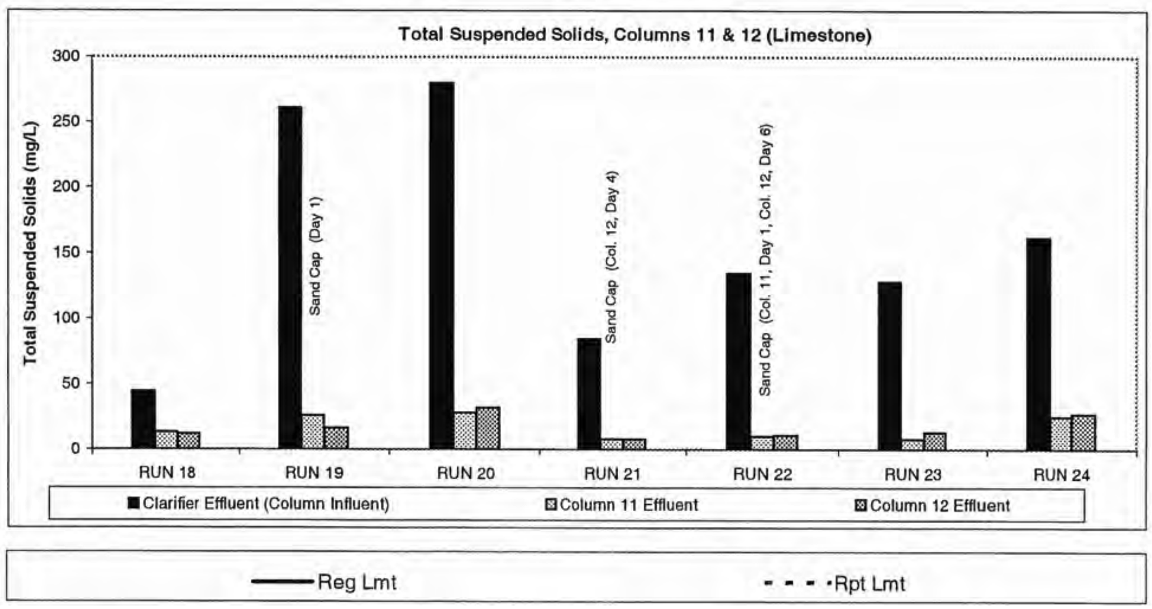


Figure 5-5. Example 4-Inch Filter Column Water Quality Bar Chart

Presented in Figures C-35 through C-166 are water quality graphs for the 4-inch filter column effluent samples. The water quality graphs for the 4-inch filter column 12-inch depth samples are shown in Figures C-167 through C-193. Shown in Figures C-194 through C-196 are water quality graphs for the column interface samples (turbidity, total phosphorus and dissolved phosphorus only).

Numerical

Each of the significant water quality parameters (regulated in the Tahoe Basin) are discussed in the subsequent subsections. Throughout the discussion, average effluent concentrations are frequently presented. When averaging values at the reporting limit, one half of the reporting limit value is used to compute the average. When calculating percent removals, when a particular parameter is reduced from measurable to below the reporting limit, that percent removal is assigned a 100 percent removal value. When a particular parameter was absent (below the reporting limit) in the influent and the effluent, that value was omitted from the data set when calculating the average column percent removal.

5.2.4 Turbidity Removal

Effluent grab samples for turbidity analyses were collected twice a day. Results of the daily turbidity measurements are summarized in Table B-21 (Appendix B). Graphs illustrating the fluctuations in the daily turbidity readings are included in Appendix C, Figures C-17 through C-34. Effluent 12-hour composite samples for turbidity and other analyses were collected once during each run at the same point in time each run (Day 3). Graphs of the once-per-run composite sample turbidities are presented in Figures C-35 through C-43 (Appendix C) and the removal of turbidity in the clarifier is shown in Figure C-44.

Summarized in Table 5-21 are turbidity removal results based both on the daily grab and once-per-run composite samples. In each case, the number of times out of the number of possible times that the limits for infiltration (200 NTU) and surface water discharge (20 NTU) were met are indicated. Average turbidities for both types of samples and percent turbidity removals for the composite samples are indicated also.

For the most part, the average effluent turbidity of the grab samples is similar to the average of the composite turbidity samples, with the results for the GFH media being the exception. Daily effluent turbidities of the GFH media filters are shown in Figures C-31 and C-32. As can be seen from these two figures, on two occasions, during the latter part of Runs 20 and 24, the turbidity increased in the last two days of the run (reason unknown). This increased the average of the daily samples but not the composite samples.

Another anomaly observed in the daily samples is an abrupt spike in effluent turbidity observed for existing F-105 sand, Superior 30 and limestone media (see Figures C-19, C-20, C-25, C-26, C-27, and C-28). For these media, the first grab samples collected at the beginning of Experimental Runs 21 and 23 had atypically high turbidities that were not consistent with the turbidities before or after that point. Both of these occurrences (at Runs 21 and 23, for the media listed) happened at the transition between double runs (runs back to back). The practice was to turn off the column feed pumps supplying one source water, open the valve on the bottom of the filter and allow it to freely drain, while the source water feed was changed over. After changeover (<1 hour later) the valve was closed and the feed pumps were turned back on with the new storm water. Opening the bottom valve could have dislodged accumulated material in the gravel underdrain, which then resulted in elevated turbidities in subsequent samples.

The following discussion of turbidity removal performance by the various media tested is based on the composite turbidity samples.

Existing Activated Alumina (28x48 Mesh DD-2)

The existing activated alumina in Column 1 was able to remove turbidity down to below the 20 NTU benchmark in all experimental runs except for Run 23 in which the effluent was 22.3 NTU. Column 2, also containing existing activated alumina, was able to reduce the effluent to below 20 NTU in all seven experimental runs. Average effluent turbidity (n = 7) was 7.8 NTU for Column 1 and 6.6 NTU for Column 2. In Phase IV, the existing activated alumina media removed an average of 96.6 percent of the turbidity.

Table 5-21. Summary of Turbidity Treatment Performance of the Various 4-Inch Filter Media Evaluated in Phase IV

Media	Filter Column Numbers	Runs	Composite Samples				Daily Samples[e]			
			Meets Infiltration Limit[a] (200 NTU)	Meets Surface Water Limit[a] (20 NTU)	Average Effluent Turbidity[b] (NTU)	Average Percent Removal[b]	Average Effluent Turbidity NTU)	Meets Infiltration Limit[a] (200 NTU)	Meets Surface Water Limit[a] (20 NTU)	Percent of Time Meets Surface Water Limit[a] (20 NTU)
Fe-Mod. AA[c]	13 & 14	18-22	10 of 10	10 of 10	0.7	99.7	0.8	31 of 31	31 of 31	100
Fe-Mod. AA[d]	13 & 14	23-24	4 of 4	0 of 4	62.8	76.9	64.0	14 of 14	1 of 14	7.1
Existing AA	1 & 2	18-24	14 of 14	13 of 14	7.2	96.6	13.3	46 of 46	38 of 46	82.6
GFH	15 & 16	18-24	14 of 14	12 of 14	8.1	96.3	28.1	44 of 46	31 of 46	67.4
AA (28x48)	5 & 6	18-24	14 of 14	9 of 14	12.4	95.6	14.8	46 of 46	32 of 46	69.6
AA (14x28)	7 & 8	18-24	14 of 14	6 of 14	37.0	89.2	45.9	46 of 46	20 of 46	43.5
Bayoxide E-33	17 & 18	18-24	14 of 14	5 of 14	51.3	86.2	59.2	44 of 46	18 of 46	39.1
Limestone	11 & 12	18-24	14 of 14	0 of 14	82.4	74.6	77.6	44 of 46	9 of 46	19.6
Existing F-105 Sand	3 & 4	18-24	14 of 14	0 of 14	82.5	74.2	82.2	42 of 46	10 of 46	21.7
Superior 30 Sand	9 & 10	18-24	14 of 14	0 of 14	88.7	72.8	82.8	43 of 46	10 of 46	21.7
AA (28x48) (PIII) [f]	1 & 2	1-12[f]	18 of 18	16 of 18	6.5	94.3	4.9	24of 24	21 of 24	87.5
F-105 Sand (PIII) [f]	3 & 4	1-12[f]	20 of 20	4 of 20	47.0	66.3	56.6	23of 24	2 of 24	8.3

[a] As established by the Lahontan Regional Water Quality Control Board (LRWQCB, 1994)
[b] Average of both replicate columns, all seven experimental runs, except where noted
[c] Experimental Runs 18 through 22, with a bed depth of 24”
[d] After removal of the upper 12” of media
[e] Average of twice per day samples for both replicate columns
[f] Phase III, Weeks 1-12

Existing F-105 Sand

The existing F-105 sand was unable to attain the 20 NTU benchmark during any of the seven experimental runs. Average effluent turbidity was 82.6 NTU for Column 3 and 82.4 NTU for Column 4. In Phase IV, even with the relatively poor performance of this media, the F-105 sand removed an average of 74.2 percent of the turbidity.

Activated Alumina (28x48 mesh DD-2)

New 28x48 mesh AA media in Columns 5 and 6 was not as successful in removing turbidity as the existing activated alumina of the same mesh size. Column 5 was able to attain the 20 NTU benchmark in four of seven runs, failing in Run 19 (effluent = 24.4 NTU), Run 20 (32.6 NTU) and Run 23 (31.2 NTU). Similarly, Column 6 was able to attain the 20 NTU benchmark in five of seven runs, failing in Run 20 (effluent = 25.1 NTU) and Run 23 (25.2 NTU). Average effluent turbidity was 15.0 NTU for Column 5 and 9.8 NTU for Column 6. The new 28x48 mesh activated alumina removed an average of 95.6 percent of the turbidity.

Activated Alumina (14x48 Mesh DD-2)

The AA media in Columns 7 and 8 (14x28 mesh DD-2) was the least successful of the AA products tested in Phase IV in removing turbidity. Column 7 was able to attain the 20 NTU benchmark in three of seven runs, failing in Runs 19, 20, 21 and 23 (effluent turbidity = 95.9, 87.8, 22.1 and 51.8, respectively). Column 8 behaved similarly. Average effluent turbidity was 40.0 NTU for Column 7 and 33.9 NTU for Column 8. The 14x28 mesh activated alumina removed an average of 89.2 percent of the turbidity.

Superior 30 Sand

Superior 30 sand in Columns 9 and 10 was unable to attain the 20 NTU treatment benchmark in any of the seven experimental runs. Average effluent turbidity was 87.2 NTU for Column 9 and 90.2 NTU for Column 10. The Superior 30 sand media removed an average of 72.8 percent of the turbidity, which is slightly less than the existing F-105 sand.

Limestone #4 Sand

Like the sand media, the limestone in Columns 11 and 12 was unable to produce an effluent below the 20 NTU benchmark. Average effluent turbidity of Column 11 was 80.2 NTU and 84.6 NTU for Column 12. The limestone media removed an average of 74.6 percent of the turbidity.

Iron-Modified Activated Alumina

The iron-modified activated alumina media was very effective in removing turbidity when the bed depth was 24” (in five of five experimental runs the turbidity was reduced to below the 20 NTU limit in both filters); however, when the upper 12 inches of media was removed (for hydraulic reasons) at the end of Run 22, both columns were unable to produce an effluent turbidity less than 20 NTU in the remaining two runs. The average effluent turbidity from Column 13 was 0.6 NTU and 0.8 NTU from Column 14 for the first five runs. After the top

12 inches were removed, the effluent increased to an average of 66.9 and 58.7 NTU, respectively. For the first five runs, when the media depth was 24 inches, the iron modified activated alumina removed 99.7 percent of the turbidity. After the media depth was reduced to 12 inches due to hydraulic failure, the media removed an average of 76.9 percent of the turbidity.

Granular Ferric Hydroxide

GFH media in Columns 15 and 16 was generally successful in removing turbidity. Column 15 was able to attain the 20 NTU benchmark in six of seven runs, failing only in Run 23 (effluent = 30.2 NTU). Similarly, Column 16 was able to attain the 20 NTU benchmark in six of seven runs, failing also in Run 20 (effluent = 46.2 NTU). The average Phase IV effluent turbidity was 6.4 NTU for Column 15 and 9.7 NTU for Column 16. The GFH media removed an average of 96.3 percent of the turbidity.

Bayoxide E-33 (Iron Oxide)

The Bayoxide media in Columns 17 and 19 was only occasionally successful in removing turbidity. Effluent from Column 17 was below the 20 NTU benchmark in three of seven runs, failing in Runs 19, 20, 21 and 23 (effluent = 108, 108, 26.1 and 34.0 NTU, respectively). Column 18 attained the turbidity benchmark in two of seven runs, failing in all runs except for Runs 18 and 22. The average effluent turbidity from Column 17 was 43.0 NTU and 59.5 NTU for Column 18. The Bayoxide E-33 media removed an average of 86.2 percent of the turbidity.

5.2.5 Total Suspended Solids Removal

Total suspended solids (TSS) concentrations measured in the effluents of the 4-inch filter columns are presented graphically in Figures C-45 through C-54 in Appendix C. Within the Tahoe Basin, there is no discharge limit for TSS established by LRWQCB; however, there is a TRPA limit of 250 mg/L of TSS for discharge to surface waters (no limit has been established by TRPA for discharge to infiltration systems). After clarification, only the storm waters used in Experimental Runs 19 and 20 were above this limit (272 and 280 mg/L, respectively). All media filters were able to drop the levels of TSS to below 250 mg/L during these two runs. Solids (i.e., TSS) removal performance by the various media tested is discussed below.

Existing Activated Alumina (28x48 mesh DD-2)

The seven run average effluent TSS concentration was 2.5 mg/L in the Column 1 effluent and 6.8 mg/L for Column 2. In Phase IV, the existing activated alumina media removed an average of 92.3 percent of the TSS. Note that the relatively poor removal of TSS by Column 1 in Run 18 (Figure C-45) dropped the collective, 2 column average from 97.7 down to 92.3 percent.

Existing F-105 Sand

Average effluent TSS was 26.0 mg/L for Column 3 and 15.6 mg/L for Column 4. In Phase IV, the existing F-105 sand removed an average of 85.9 percent of the TSS.

Activated Alumina (28x48 mesh DD-2)

The average TSS concentration in the Column 5 effluent was 5.2 mg/L over the seven experimental runs. TSS concentration in the Column 6 effluent averaged 3.7 mg/L. Collectively, the new 28x48 mesh activated alumina removed an average of 96.1 percent of the TSS (higher than the existing media tested in Columns 1 and 2).

Activated Alumina (14x48 mesh DD-2)

The average effluent TSS concentration was 10.9 mg/L for Column 7 and 11.1 mg/L for Column 8. The 14x28 mesh activated alumina removed an average of 94.2 percent of the TSS, which is 2 percent less than the finer 28x48 mesh material.

Superior 30 Sand

Effluent from the Superior 30 sand in Columns 9 and 10 had average effluent concentrations of 20 mg/L and 21 mg/L, respectively. The Superior 30 sand media removed an average of 85.4 percent of the TSS, which is essentially equivalent to the existing F-105 sand in Columns 1 and 2.

Limestone #4 Sand

Like the sand media, the limestone in Columns 11 and 12 was not as successful in removing TSS as the other media evaluated. Average effluent TSS of Columns 11 and 12 was 12 mg/L. Collectively, the limestone media removed an average of 87.4 percent of the TSS.

Iron-Modified Activated Alumina

The average (n = 5) effluent TSS concentration in Column 13 when the bed depth was 24 inches was 1.9 mg/L. After Run 22 when the upper 12 inches of media were removed the effluent average (n = 2) TSS increased to 22.5 mg/L. Similarly, the effluent average TSS concentration for Column 14 increased from 3.0 to 21.0 mg/L after removal of the top 12 inches of media. For the first five runs, the iron modified activated alumina removed 98.0 percent of the TSS.

Granular Ferric Hydroxide

GFH media in Columns 15 and 16 was generally successful in removing TSS. The average Phase IV effluent TSS was 5.0 mg/L for Column 15 and 4.0 mg/L for Column 16. The GFH media columns removed an average of 95.0 percent of the TSS.

Bayoxide E-33 (Iron Oxide)

The average effluent TSS was 11.0 mg/L from both Columns 17 and 18. The Bayoxide E-33 media removed an average of 93.1 percent of the TSS.

TSS Removal Summary

TSS removal performances of the various media evaluated in Phase IV are summarized in Table 5-22. As expected, the removal of TSS was correlated with the removal of turbidity

(Table 5-21). Again, the iron-modified activated alumina had the highest percent removal of any of the media when the media depth was 24 inches; however, hydraulically, this filter was a failure. If the poor performance of Column 1 in Run 18 is eliminated, the existing 28x48 mesh activated alumina in Columns 1 and 2 would be the second best performing media with respect to suspended solids removal. All media tested attained substantial reductions in TSS.

Table 5-22. Summary of TSS Treatment Performance of the various 4-Inch Filter Media Evaluated in Phase IV

Media	Filter Column Numbers	Runs	Average Eff. TSS (mg/L)	Average Percent Removal
Fe-Mod AA	13 and 14	18 - 22 23 - 24	3 22	98.0 85.4
AA (28x48)	5 and 6	18 – 24	5	96.1
GFH	15 and 16	18 – 24	5	95.0
AA (14x28)	7 and 8	18 – 24	11	94.2
Bayoxide	17 and 18	18 – 24	11	93.1
Existing AA	1 and 2	18 – 24	5	92.3
Limestone	11 and 12	18 – 24	12	87.4
Existing F-105 Sand	3 and 4	18 – 24	21	85.9
Superior 30 Sand	9 and 10	18 – 24	20	85.4

5.2.6 Phosphorus Removal

The total phosphorus discharge limits established by the LRWQCB are 0.1 mg-P/L for discharge to surface water and 1.0 mg-P/L for discharges to infiltration type systems. TRPA has established similar discharge limits; however, the limits are based on dissolved phosphorus concentrations. The total and dissolved phosphorus removal performance of each of the media evaluated in Phase IV is discussed in the following text.

Total Phosphorus

Total phosphorus in the pilot plant influent storm water ranged from a low of 0.13 mg-P/L (Run 18) to a high of 1.24 mg-P/L (Run 21) with an average of 0.58 mg-P/L. After clarification, the average total phosphorus level decreased to 0.35 mg-P/L (Range 0.10 to 0.58 mg-P/L). Total phosphorus (Phos-T) removals by the filter columns are presented graphically in Figures C-55 through C-64 in Appendix C.

Existing Activated Alumina (28x48 mesh DD-2)

The existing activated alumina in Column 1 was able to remove the total Phos-T concentration down to below the 0.1 mg-P/L benchmark in all experimental runs except for Run 22 in which the effluent was 0.11 mg-P/L. The existing activated alumina in Column 2 was able to reduce the effluent to below 0.1 mg-P/L in all seven experimental runs. Average effluent Phos-T (n=7) was 0.032 mg-P/L for Column 1 (slightly above the reporting limit of 0.03 mg-P/L) and <0.03 mg-

P/L for Column 2. In Phase IV, the existing activated alumina media removed an average of 96.6 percent of the Phos-T.

Existing F-105 Sand

The existing F-105 sand (Figure C-56) was occasionally able to attain the 0.1 mg-P/L benchmark for Phos-T. Column 3 was able to attain the 0.1 mg-P/L benchmark in three of seven runs, failing in Run 20 (effluent = 0.12 mg-P/L), Run 22 (0.19 mg-P/L), Run 23 (0.26 mg-P/L) and Run 24 (0.40 mg-P/L). Similarly, Column 4 was able to attain the 0.1 mg-P/L benchmark in four of seven runs, failing in Run 22 (effluent = 0.18 mg-P/L), Run 23 (0.27 mg-P/L) and Run 24 (0.44 mg-P/L). The existing F-105 Filter columns removed an average of 63.4 percent of the Phos-T.

Activated Alumina (28x48 mesh DD-2)

New 28x48 mesh activated alumina media in Columns 5 and 6 was successful in removing Phos-T in the majority of runs (one minor exception). Column 5 was able to attain the 0.1 mg-P/L benchmark in six of seven runs, failing only in Run 22 (effluent = 0.11 mg-P/L). Column 6 was able to attain the 0.1 mg-P/L benchmark in all seven runs. Average effluent Phos-T was <0.03 mg-P/L for both filter columns. The new 28x48 mesh activated alumina removed an average of 95.5 percent of the Phos-T.

Activated Alumina (14x48 mesh DD-2)

The activated alumina media in Columns 7 and 8 (14x28 mesh DD-2) was successful in removing Phos-T to the 0.1 mg/L benchmark for surface discharge. Average effluent Phos-T was 0.04 mg-P/L for Column 7 and 0.034 mg-P/L for Column 8. The 14x28 mesh activated alumina removed an average of 92.4 percent of the Phos-T.

Superior 30 Sand

Superior 30 sand in Columns 9 and 10 was unable to consistently attain the 0.1 mg-P/L treatment benchmark (the limit met three of seven times for both columns). Average effluent Phos-T was 0.16 mg-P/L for Column 9 and 0.15 mg-P/L for Column 10. The Superior 30 sand media removed an average of 62.1 percent of the Phos-T, which is slightly less than the existing F-105 sand.

Limestone #4 Sand

Like the sand media, the limestone in Columns 11 and 12 was only moderately successful in reducing Phos-T levels to the 0.1 mg-P/L benchmark (three of seven times, both columns). Average effluent Phos-T of Column 11 was 0.18 mg-P/L and 0.14 mg-P/L for Column 12. The limestone media removed an average of 60.0 percent of the Phos-T.

Iron-Modified Activated Alumina

The iron-modified activated alumina media was very effective in removing Phos-T, regardless of bed depth. Columns 13 and 14 both attained the 0.1 mg-P/L Phos-T benchmark six of seven times, failing only in Run 22 (effluent = 0.11 mg-P/L and 0.17 mg-P/L, respectively). Run 22 was at the point of catastrophic hydraulic failure of the filters. Enough effluent was flowing to capture a full sample, but hydraulic failure was imminent. After flow was restored by removing the upper 12 inches of media, the effluent Phos-T for the last two experimental runs was <0.03 mg-P/L for both filters. Column 13 had an average (n = 7) effluent Phos-T concentration of <0.03 mg-P/L. Column 14 had an average (n = 7) effluent Phos-T concentration of 0.04 mg-P/L. The iron-modified activated alumina media removed an average (7 runs) of 93.4 percent of the Phos-T in the settled influent storm water.

Granular Ferric Hydroxide

GFH media in Columns 15 and 16 was generally successful in removing Phos-T. Column 15 was able to attain the 0.1 mg-P/L benchmark in six of seven runs, failing only in Run 22 (effluent = 0.15 mg-P/L). Similarly, Column 16 was able to attain the 0.1 mg-P/L benchmark in six of seven runs, failing also in Run 22 (effluent = 0.38 mg-P/L). The average Phase IV effluent Phos-T was 0.034 mg-P/L for Column 15 and 0.069 mg-P/L for Column 16. The GFH media removed an average of 88.2 percent of the Phos-T.

Bayoxide E-33 (Iron Oxide)

The Bayoxide media in Columns 17 and 19 was generally successful in removing Phos-T. Effluent from Column 17 was at or below the 0.1 mg-P/L benchmark in six of seven runs, failing in Run 20 (effluent = 0.14 mg-P/L). Column 18 also attained the Phos-T benchmark in six out of seven runs, failing only in Run 22 (0.19 mg-P/L). The average effluent Phos-T from Column 17 was 0.049 mg-P/L and 0.050 mg-P/L for Column 18. The Bayoxide E-33 media removed an average of 88.4 percent of the Phos-T.

Total Phosphorus Removal Summary: Phos-T removal performances for the various media evaluated in Phase IV are summarized in Table 5-23. The activated alumina media demonstrated superior total phosphorus removals as compared to the non-aluminum based media. The existing activated alumina (28x48 mesh) and the new activated alumina (28x48 mesh) had the best average percent removals; however, the coarse mesh activated alumina met the surface discharge limit all 14 times. The Bayoxide and GFH media had better total phosphorus removal than the sand and limestone media. Even the sand filters attained better than 50 removal of the total phosphorus load applied.

Dissolved Phosphorus

The dissolved phosphorus concentration in the raw influent ranged from <0.03 mg-P/L (Run 19) to 0.33 mg-P/L (Run 24) with an average of 0.11 mg-P/L. After clarification, the average dissolved phosphorus level decreased only slightly to 0.12 mg-P/L; however, dissolved phosphorus was absent in 3 of the 7 experimental runs (Runs 18, 19 and 21). Percent removals and average effluent concentrations were therefore only calculated for the runs when Phos-D was present in the influent. Dissolved phosphorus (Phos-D) bar charts are shown in Figures C-65 through C-74. A discussion of the removals of Phos-D by the various media filters follows.

Table 5-23. Summary of Phos-T Treatment Performance of the various 4-Inch Filter Media Evaluated in Phase IV

Media	Filter Column Numbers	Meets Infiltration Limit [a] (1 mg-P/L)	Meets Surface Water Limit [a] (0.1 mg-P/L)	Average Eff. Phos-T (mg-P/L)	Average Percent Removal
Existing AA	1 and 2	14 of 14	13 of 14	<0.03	96.6
AA (28x48)	5 and 6	14 of 14	13 of 14	<0.03	95.5
Fe-Mod AA	13 and 14	14 of 14	12 of 14	<0.03	93.4
AA (14x28)	7 and 8	14 of 14	14 of 14	0.04	92.4
Bayoxide	17 and 18	14 of 14	12 of 14	0.05	88.4
GFH	15 and 16	14 of 14	12 of 14	0.05	88.2
Existing F-105 Sand	3 and 4	14 of 14	7 of 14	0.15	63.4
Superior 30 Sand	9 and 10	14 of 14	6 of 14	0.16	62.1
Limestone	11 and 12	14 of 14	7 of 14	0.16	60.0

[a] As established by the Lahontan Regional Water Quality Control Board (LRWQCB, 1994)

Existing Activated Alumina (28x48 mesh DD-2)

Average effluent Phos-D (n = 4) was 0.039 mg-P/L for Column 1 (reporting limit is <0.03 mg-P/L) and <0.03 mg-P/L for Column 2. When Phos-D was present in the influent, the existing activated alumina media removed an average of 90.2 percent of the Phos-D.

Existing F-105 Sand

Average effluent Phos-D (n = 4) was 0.18 mg-P/L for both Columns 3 and 4. The existing F-105 Filter columns removed an average of 25.7 percent of the Phos-D.

Activated Alumina (28x48 mesh DD-2)

New 28x48 mesh activated alumina media in Columns 5 and 6 was generally successful in removing Phos-D from the storm water. Average effluent Phos-D was 0.036 mg-P/L in the Column 5 effluent and 0.034 mg-P/L in the effluent from Column 6. The new 28x48 mesh activated alumina removed an average (n = 4) of 83.0 percent of the Phos-D load.

Activated Alumina (14x48 mesh DD-2)

Average effluent Phos-D was 0.031 mg-P/L for Column 7 and 0.036 mg-P/L for Column 8. For the runs in which Phos-D was present in the influent, the 14x28 mesh activated alumina removed an average of 83.9 percent of the Phos-D.

Superior 30 Sand

Average effluent Phos-D was 0.17 mg-P/L for Column 9 and 0.15 mg-P/L for Column 10. For the 4 runs, the Superior 30 sand media removed an average of 38.0 percent of the Phos-D.

Limestone #4 Sand

Average effluent Phos-D of Column 11 was 0.19 mg-P/L and 0.16 mg-P/L for Column 12. The limestone media removed an average (n = 4) of 26.2 percent of the Phos-D.

Iron-Modified Activated Alumina

As observed with Phos-T, the iron-modified activated alumina media was still effective in removing Phos-D when the bed depth was reduced to 12 inches. Column 13 had an average (n = 4) effluent Phos-D concentration of <0.03 mg-P/L. Column 14 had and average (n = 4) effluent Phos-D concentration of 0.034 mg-P/L. The iron-modified activated alumina media removed an average (4 runs) of 86.6 percent of the Phos-D in the settled influent storm water.

Granular Ferric Hydroxide

Average (n = 4) effluent Phos-D was 0.036 mg-P/L for both Columns 15 and 16. The GFH media removed an average (n = 4) of 82.1 percent of the Phos-D.

Bayoxide E-33 (Iron Oxide)

Average (n = 4) effluent Phos-D from Column 17 was 0.031 mg-P/L and 0.039 mg-P/L for Column 18. The Bayoxide E-33 media removed an average (n = 4) of 83.0 percent of the Phos-D.

Dissolved Phosphorus Removal Summary

Phos-D removal performances for the various media evaluated in Phase IV are summarized in Table 5-24. As observed with Phos-T removal, the aluminum-based media generally demonstrated superior Phos-D removals (GFH being the exception). The iron modified activated alumina provided the best Phos-D removals. New 28x48 mesh activated alumina was superior to the existing material for the removal of Phos-D. The limestone and sand media demonstrated little ability to remove dissolved phosphorus.

Table 5-24. Summary of Phos-D Treatment Performance of the various 4-Inch Filter Media Evaluated in Phase IV

Media	Filter Column Numbers	Runs	Average Eff. Phos-D (mg-P/L)	Average Percent Removal
Existing AA	1 and 2	20, 22, 23, 24	<0.03	90.2
Fe-Mod AA	13 and 14	20, 22, 23, 24	<0.03	86.6
AA (14x28)	7 and 8	20, 22, 23, 24	0.03	83.9
AA (28x48)	5 and 6	20, 22, 23, 24	0.04	83.0
Bayoxide	17 and 18	20, 22, 23, 24	0.04	83.0
GFH	15 and 16	20, 22, 23, 24	0.04	82.1
Superior 30 Sand	9 and 10	20, 22, 23, 24	0.16	38.0
Limestone	11 and 12	20, 22, 23, 24	0.18	26.2
Existing F-105 Sand	3 and 4	20, 22, 23, 24	0.18	25.7

5.2.7 Nitrogen Removal

Nitrogen in waters discharged within the Tahoe Basin is regulated as "Total Nitrogen". Analytically, total nitrogen (Total-N) is typically calculated, rather than measured directly. Total nitrogen is widely accepted to be the sum of the nitrate, nitrite and total Kjeldahl nitrogen (TKN). Phase IV laboratory determinations included the measurement of both filtered (TKN-D) and unfiltered (TKN-T) total Kjeldahl nitrogen. Nitrate + nitrite nitrogen was analyzed as a combined total. Ammonia nitrogen is a component of the TKN and was not separately measured in Phase IV.

The Tahoe Basin regulatory limit for nitrogen is 0.5 mg-N/L for discharge to surface water and 5 mg-N/L for infiltration systems (as total nitrogen for LRWQCB and as dissolved nitrogen for TRPA, see Section 2.1). Total Kjeldahl nitrogen was present in the influent storm water (used to feed the clarifier) at levels above the LRWQCB surface water discharge limit in six of seven runs (average TKN-T = 1.2 mg-N/L). Unlike previous project phases, the dissolved TKN fraction (TKN-D) in the raw storm water was typically below the surface water discharge limit (average TKN-D = 0.30 mg-N/L). Since combined nitrate + nitrite was present in only one of the seven storm waters tested (0.12 mg-N/L in Run 18), total nitrogen was essentially equal to TKN-T and dissolved nitrogen was essentially equal to TKN-D.

Total Nitrogen (Primarily as TKN-T)

Raw storm water Total-N ranged from a low of 0.27 mg-N/L (Run 21, a rain event water collected from roadside basins and boxes) to a high of 2.11 mg-N/L (Run 20, snowmelt water collected from the on-site basin) with an average Total-N concentration of 1.23 mg-N/L (n = 7). After clarification, the average Total-N decreased slightly to 1.07 mg-N/L but was present in the influent water in excess of the 0.5 mg-N/L treatment benchmark in six of seven runs. In Runs 21 and 23, the clarifier effluent contained more Total-N than measured in the raw influent. The reason for this is unclear, but possibly can be attributed to the inherent variability in the analytical measurement of TKN or perhaps to the release of nitrogen from accumulated material in the clarifier.

Effluent Total-N concentrations from the 4-inch filter columns are shown in Figures C-75 through C-84 (with TKN presented in Figures C-85 through C-94). The Total-N removal performance of each of the media evaluated in Phase IV is discussed in the following text.

Existing Activated Alumina (28x48 mesh DD-2)

Both filters were able to lower the nitrogen level to below the surface discharge limit of 0.5 mg/L in six of seven runs, failing in Run 24, the last run conducted in Phase IV when the influent Total-N level was very low (0.37 mg-N/L). Average effluent Total-N (n = 7) was 0.28 mg-N/L for Column 1 (reporting limit is <0.10 mg-N/L) and 0.25 mg-N/L for Column 2. Both columns demonstrated the ability to remove Total-N in all but the last run (see Figure C-75). This might be attributed to analytical variation or a release of accumulated nitrogen containing materials. Note that hydraulic failure was occurring in Run 24 and the flow was restored only by replacing both the cap and upper 1 inch of media. The average (n = 7) Total-N removal measured in the effluent of the columns containing the existing 28x48 mesh activated alumina media was

62.3 percent (86.5 percent removal, excluding the negative percent removals measured in Run 24).

Existing F-105 Sand

Both of the existing F-105 filters demonstrated removal of nitrogen in all runs (Figure C-76). Column 3 was able to reduce the Total-N down to the surface discharge limit six of seven runs, narrowly missing in Run 20 (effluent = 0.51 mg-N/L). Column 4 was able to meet the limit in all seven runs. Average effluent Total-N (n = 7) concentration from the filter columns containing the existing F-105 sand was 0.31 mg-N/L for Column 3 and 0.30 mg-N/L from Column 4. The existing F-105 filter columns removed an average of 71.2 percent of the Total-N.

Activated Alumina (28x48 mesh DD-2)

Because of the contribution of nitrogen from the nitrate present in Run 18 and poor performance in Run 24 (Figure C-77), the new 28x48 mesh activated media in Column 5 was able to attain the total nitrogen benchmark in five of seven runs. Column 6 was able to remove nitrogen down to the benchmark in six of seven runs, also failing in Run 18. Like the existing 28x48 mesh activated alumina, a net increase in Total-N was observed in Run 24. Average effluent Total-N was 0.29 mg-N/L in the Column 5 effluent and 0.24 mg-N/L in the effluent from Column 6. The new 28x48 mesh activated alumina removed an average (N = 7) of 65.1 percent of the Total-N load (86.2% removal, excluding the negative percent removals measured in Run 24).

Activated Alumina (14x48 mesh DD-2)

Column 7 was able to reduce the Total-N down to the surface discharge limit in six of seven runs, narrowly missing in Run 20 (effluent = 0.51 mg-N/L). Column 8 was able to meet the limit in all seven runs. Average effluent Total-N was 0.27 mg-N/L for Column 7 and 0.25 mg-N/L for Column 8. The 14x28 mesh activated alumina removed an average (n = 7) of 76.8 percent of the Total-N.

Superior 30 Sand

Column 9 was able to reduce the Total-N levels to below the benchmark in six of seven runs; however, for unknown reasons, Column 10 was only able to attain the benchmark in three of seven runs (Figure C-79). With the exception of the last experimental run (Run 24), the turbidity and TSS removal between the replicates was similar. Average effluent Total-N was 0.38 mg-N/L for Column 9 and 0.56 mg-N/L for Column 10. Averaging the performance of both columns for the seven experimental runs, the Superior 30 sand media removed an average of 49.2 percent of the Total-N.

Limestone #4 Sand

Unlike turbidity, the limestone media was reasonably successful in reducing Total-N levels. Columns 11 and 12 attained the treatment benchmark in six and five of seven runs, respectively (Figure C-80). Average effluent Total-N of Column 11 was 0.41 mg-N/L and 0.45 mg-N/L for Column 12. Collectively, the limestone media removed an average (n = 7) of 53.8 percent of the Total-N.

Iron-Modified Activated Alumina

Column 13 was effective in removing Total-N when the bed depth was 24 inches, but after the removal of the upper 12 inches of media, the effectiveness decreased. For unknown reasons, bed depth was not a factor for Column 14. Effluent from Column 13 attained the treatment benchmark five of five runs when the depth was 24 inches and zero of two when the bed depth was reduced to 12 inches. Column 14 attained the Total-N treatment benchmark in all seven experimental runs. Column 13 had an average (n = 7) effluent Total-N concentration of 0.38 mg-N/L. Column 14 had an average (n = 7) effluent Total-N concentration of 0.13 mg-N/L. Collectively, the iron-modified activated alumina media removed an average of 87.7 percent of the Total-N in the first five experimental runs and only 7 percent in Runs 23 and 24.

Granular Ferric Hydroxide

Column 15 attained the treatment benchmark in four of seven runs. Column 16 was able to produce an effluent below the benchmark in five of the seven runs. Average (n = 7) effluent Total-N was 0.44 mg-N/L for Column 15 and 0.38 mg-N/L for Column 16. The GFH media removed an average (n = 7) of 43.3 percent of the Total-N load.

Bayoxide E-33 (Iron Oxide)

The Bayoxide media was able to produce an effluent below the 0.5 mg-N/L benchmark in five of seven runs for both columns. As with some of the other media, a net increase in Total-N was observed in Run 24 (Figure C-83). The average (n = 7) effluent Total-N from Column 17 was 0.42 mg-N/L for both filters. The Bayoxide E-33 media removed an average (n = 7) of 51.6 percent of the Total-N load.

Total Nitrogen Summary

A tabular summary of total nitrogen treatment performance is presented in Table 5-25. Although subject to hydraulic failure, the iron-modified activated alumina media with a bed depth of 24 inches was the best media for the removal of Total-N. New 28x48 mesh activated alumina was superior to the existing material by a few percentage points. The existing F-105 sand performed unexpectedly well, producing effluents appreciably lower in Total-N than the finer grained Superior 30 sand. The iron based media (GFH and Bayoxide) were only moderately successful in lowering Total-N levels in the settled storm water.

Dissolved Nitrogen (Primarily TKN-D)

Raw storm water TKN-D ranged from a low of <0.1 mg-N/L (Runs 19, 20 and 22) to a high of 1.06 mg-N/L (Run 18) with an average of 0.29 mg-N/L (n = 7). After clarification, the average increased slightly to 0.30 mg-N/L. Dissolved TKN-D was only present in five of seven runs and generally at low levels. The storm water used in Run 19 was the only water in which the TKN-D concentration exiting the clarifier was above the LRWQCB/TRPA limit of 0.5 mg-N/L (Run 19 clarifier TKN-D = 0.57 mg-N/L).

Table 5-25. Summary of Total-N Treatment Performance of the various 4-Inch Filter Media Evaluated in Phase IV

Media	Filter Column Numbers	Meets Infiltration Limit[a] (5 mg-N/L)	Meets Surface Water Limit[a] (0.5 mg-N/L)	Average Eff. Total-N[b] (mg-N/L)	Average Percent Removal[b]
Fe-Mod AA	13 and 14	14 of 14	10 of 10[c]	0.18[c]	87.7[c]
			2 of 4[d]	0.46[d]	7.0[d]
AA (14x28)	7 and 8	14 of 14	13 of 14	0.26	76.8
Existing F-105 Sand	3 and 4	14 of 14	13 of 14	0.31	71.2
AA (28x48)	5 and 6	14 of 14	11 of 14	0.27	65.1
Existing AA	1 and 2	14 of 14	12 of 14	0.27	62.3
Limestone	11 and 12	14 of 14	11 of 14	0.43	53.8
Bayoxide	17 and 18	14 of 14	10 of 14	0.42	51.6
Superior 30 Sand	9 and 10	14 of 14	9 of 14	0.47	49.2
GFH	15 and 16	14 of 14	9 of 14	0.41	43.3

[a] As established by the Lahontan Regional Water Quality Control Board (LRWQCB, 1994)
[b] Average of both replicate columns, all 7 experimental runs, except where noted.
[c] Experimental Runs 18 through 22, with a bed depth of 24"
[d] After removal of the upper 12" of media (data from Runs 23 and 24 only)

Effluent TKN-D concentrations from the 4-inch filter columns are shown in Figures C-95 through C-104 (Appendix C). The removal of TKN-D in the various media filters was inconsistent. A tabular summary of dissolved TKN (equal to dissolved nitrogen except in Run 18) removal treatment performance is presented in Table 5-26. Percent removals and average effluent concentration values were not included in the averages when TKN-D was absent in the influent (Runs 21 and 24) unless there was a net production or increase in TKN-D concentration during filtration.

The finer grained activated alumina media removed the highest percentage of TKN-D from the settled storm water; however, because of the low TKN-D levels involved, caution should be used in interpretation of the results (the influent TKN-D averaged [n = 7] 0.30 mg-N/L). Several of the media removed 50-75 percent of the influent TKN-D load consistently. Poor performance in one run can greatly effect the overall percent removal (as example, the 14x28 mesh activated alumina media filters performed poorly in Run 21, lowering the average percent removal from 71 percent to -23). Overall, the activated alumina media do remove some of the dissolved nitrogen fraction. Observations made in previous phases of this pilot program indicate that consistent removal of some portion of the dissolved nitrogen fraction is often necessary to attain the 0.5 mg-N/L level required for discharge to surface waters.

Table 5-26. Summary of TKN-D Treatment Performance of the various 4-Inch Filter Media Evaluated in Phase IV

Media	Filter Column Numbers	Runs	Average Eff. TKN-D (mg-N/L)	Average Percent Removal
Fe-Mod AA	13 & 14	18-24	0.13	76.0
AA (28x48)	5 & 6	18-24	0.13	75.2
Existing AA	1 & 2	18-24	0.10	57.7
GFH	15 & 16	18-24	0.14	36.3
AA (14x28)	7 & 8	18-24	0.12	-23.8
Bayoxide	17 & 18	18-24	0.20	-40.9
Existing F-105 Sand	3 & 4	18-24	0.18	-66.2
Limestone	11 & 12	18-24	0.28	-123
Superior 30 Sand	9 & 10	18-24	0.32	-131

5.2.8 Iron Removal

The Lake Tahoe Basin total iron effluent limits are 500 µg/L (0.5 mg/L) for surface waters and 4,000 µg/L (4 mg/L) for discharges to infiltration systems (LRWQCB, 1994). The TRPA has the same limits; however, it is the dissolved fraction that is regulated. Data from Phase II and III shows that the activated alumina media is generally effective in reducing the iron concentration to below the treatment benchmark of 500 µg/L. In Phase IV, the only media monitored for total and dissolved iron (Fe-T and Fe-D) included the Superior 30 sand (Columns 9 and 10), limestone (Columns 11 and 12), iron-modified activated alumina (Columns 13 and 14), granular ferric hydroxide (Columns 15 and 16) and Bayoxide E-33 (Columns 17 and 18).

Total and dissolved iron was present in the Phase IV raw storm water at an average of 12,620 µg/L and 75 µg/L, respectively. After clarification, the average Fe-T and Fe-D levels were 7,660 µg/L and 112 µg/L, respectively (note the slight increase in the average Fe-D concentration following clarification). The concentration of Fe-T in the clarified storm water used to feed the filter columns was above the 500 µg/L level in all experimental runs. In five of the seven runs the clarifier effluent exceeded the 4,000 µg/L limit for discharge to an infiltration system. For all of the experimental runs, the influent dissolved iron was below the regulatory effluent limitation. Therefore, removal of particulate iron alone would allow compliance.

Total iron removal through the various treatment processes is illustrated in Figures C-105 through 110 (Appendix C). Dissolved iron removal is illustrated in Figures C-111 through C-116. A tabular summary of the Fe-T removal performances of the various media is presented in Table 5-27.

Table 5-27. Summary of Fe-T Treatment Performance of the Various 4-Inch Filter Media Evaluated in Phase IV

Media	Filter Column #	Runs	Meets Infiltration Limit[a] (4000 µg/L)	Meets Surface[a] Water Limit (500 µg/L)	Average Eff. Fe-T[b] (µg/L)	Average Percent Removal
Fe-Mod AA	13 & 14	18-22	10 of 10	10 of 10	<25	99.9
		18-24	14 of 14	10 of 14	493	92.5
		23-24	4 of 4	0 of 4	1,690	74.0
GFH	15 & 16	18-24	14 of 14	12 of 14	213	96.1
Bayoxide	17 & 18	18-24	14 of 14	5 of 14	1,260	84.8
Limestone	11 & 12	18-24	14 of 14	0 of 14	2,046	70.9
Superior 30 Sand	9 & 10	18-24	12 of 14	0 of 14	2,143	69.3
Existing AA	1 & 2	Fe not measured				
Existing F-105 Sand	3 & 4	Fe not measured				
AA (28x48)	5 & 6	Fe not measured				
AA (14x28)	7 & 8	Fe not measured				

[a] As established by the Lahontan Regional Water Quality Control Board (LRWQCB, 1994)

The iron modified activated alumina demonstrated near 100 percent removal of Fe-T when the bed depth was 24 inches. For the last two runs (12 inch bed depth) the removal percentage decreased appreciably and the effluent no longer attained the benchmark for surface water discharge. The Bayoxide, limestone and Superior 30 sand media were unable to adequately treat iron levels to the required benchmark level for surface discharge. The GFH media removed a high percentage of the iron (96.1%) from the storm water but was unable to meet the benchmark in all of the runs.

Several of the new media were iron-based. A concern was whether iron levels, primarily dissolved, would increase due to filtration through these media. Effluent Fe-D levels from the iron-modified activated alumina, GFH and Bayoxide media were always below the reporting limit (<25 µg/L). Effluent from the limestone and Superior 30 sand contained measurable Fe-D (40-41 µg/L).

5.2.9 Effluent Aluminum

There is no specific numerical limit for aluminum levels in waters discharged within the Lake Tahoe Basin. However, the USEPA aquatic chronic toxicity guideline for aluminum (when biologically available, i.e., dissolved) is 87 µg/L (Brooke and Stephan, 1988) and aluminum levels are implicitly regulated based on narrative toxicity requirements. The influent storm water used contained substantial levels of total aluminum (Al-T, average = 7,714 µg/L). After clarification, the Al-T average decreased to 5,083 µg/L (range from 1,360 to 10,458 µg/L). Total aluminum concentrations in the influent and in the effluents from the 4-inch filter columns are presented in Figures C-117 through C-126 (Appendix C). Each of the various aluminum fractions is discussed in the following sections.

Total Aluminum

Average effluent Al-T concentrations and the percent removals observed in the various filters are presented in Table 5-28. The best removal of Al-T was observed in the iron-modified activated aluminum filters (nearly 100%) when the bed depth was 24 inches. After the removal of the upper 12 inches of media, the removal efficiency dropped dramatically. The existing activated alumina, GFH, and 28x48 mesh activated alumina media all demonstrated removals in excess of 90 percent of total aluminum. The sand columns removed the least amount of Al-T.

Table 5-28. Summary of Al-T Treatment Performance of the various 4-Inch Filter Media Evaluated in Phase IV

Media	Filter Column Numbers	Runs	Average Eff. Al-T (µg/L)	Average Percent Removal
Fe-Mod AA	13 & 14	18-22	<25	99.9
		18-24	388	92.9
		23-24	1,320	73.1
GFH	15 & 16	18-24	161	95.8
Existing AA	1 & 2	18-24	177	95.2
AA (28x48)	5 & 6	18-24	301	92.3
Bayoxide	17 & 18	18-24	890	84.1
AA (14x28)	7 & 8	18-24	798	83.0
Limestone	11 & 12	18-24	1,470	69.1
Superior 30 Sand	9 & 10	18-24	1,561	68.7
Existing F-105 Sand	3 & 4	18-24	2,988	54.5

Dissolved Aluminum

Dissolved aluminum (Al-D) levels in the filter effluents are shown in Figures C-127 through C-136. Dissolved aluminum was present in only one of seven clarifier effluent samples at levels above the reporting limit (27 µg/L in Run 23). Dissolved aluminum levels generally decreased with filtration in all columns, except for both new activated alumina media (28x48 and 14x28 mesh) and the limestone. Average effluent Al-D concentrations and the percent removals observed in the various filters are presented in Table 5-29.

Table 5-29. Summary of Al-D Treatment Performance of the various 4-Inch Filter Media Evaluated in Phase IV

Media	Filter Column Numbers	Runs	Average Eff. Al-D (µg /L)	Average Percent Removal
Fe-Mod AA	13 & 14	18-22	<25	100
Superior 30 Sand	9 & 10	18-24	<25	100
Existing AA	1 & 2	18-24	<25	64.5
Bayoxide	17 & 18	18-24	<25	19.1
Existing F-105 Sand	3 & 4	18-24	<25	11.5
GFH	15 & 16	18-24	<25	-14.7
Limestone	11 & 12	18-24	30	-130
AA (28x48)	5 & 6	18-24	54	-249
AA (14x28)	7 & 8	18-24	64	-374

Filtration with the new 28x48 mesh increased dissolved aluminum levels by nearly 250 percent (Figure C-129). Filtration with 14x28 mesh activated alumina increased effluent Al-D by almost 375% (Figure C-130). Most of the increase was in the first experimental run, which simulates a little over a year of flow in the field. The 28x48 mesh activated alumina increased the effluent Al-D by an average of 135 µg/L in Run 18. Similarly, the 14x28 mesh activated alumina increased the effluent Al-D by an average of 184 µg/L in Run 18. The increase in effluent Al-D levels observed in the limestone filters was less significant (Figure C-132) and perhaps due to an increase in aluminum solubility due to the elevated effluent pH (aluminum would be mobilized out of accumulated solids at elevated pH) . No increase in Al-D was noted with the existing activated alumina filters. This indicates that as the activated alumina filter media matures, it ceases to emit/leach Al-D. Also of note is that Al-D is typically absent in the effluent from the iron-modified activated alumina media, perhaps indicating the iron modification prevents the aluminum from becoming soluble or otherwise leaching.

Acid Soluble Aluminum

The concentrations of acid soluble aluminum in the clarified storm water averaged 360 µg/L. Acid soluble aluminum (Al-AS) levels in the filter effluents are shown in Figures C-137 through C-146. Average effluent Al-AS concentrations and the percent removals observed in the various filters are presented in Table 5-30.

The iron-modified activated alumina media removed nearly 100 percent of the Al-AS (99.7 percent) regardless of bed depth. The average effluent from the existing activated alumina, GFH and the new 28x48 mesh activated alumina was below the 87 µg/L level. All other media, including the coarse mesh activated alumina had average percent removals less than 50 percent and average effluents greater than 87 µg/L.

Table 5-30. Summary of Al-AS Treatment Performance of the various 4-Inch Filter Media Evaluated in Phase IV

Media	Filter Column Numbers	Runs	Average Eff. Al-AS (µg /L)	Average Percent Removal
Fe-Mod AA	13 & 14	18-22	<25	99.7
Existing AA	1 & 2	18-24	52	88.5
GFH	15 & 16	18-24	54	73.0
AA (28x48)	5 & 6	18-24	85	63.4
Bayoxide	17 & 18	18-24	139	43.1
Existing F-105 Sand	3 & 4	18-24	218	26.4
AA (14x28)	7 & 8	18-24	162	25.0
Limestone	11 & 12	18-24	223	24.2
Superior 30 Sand	9 & 10	18-24	214	22.9

5.2.10 pH and Alkalinity

The performances of the 4-inch columns with respect to pH and alkalinity are considered below.

pH

The Lahontan Basin Plan water quality objective for the pH of surface water is that "the pH shall not be depressed below 6.5 nor raised above 8.5" (LRWQCB, 1994). The pH of the storm water collected ranged from 7.2 to 8.1 with an average of 7.4. After clarification the seven-run average pH was 7.5, which is slightly above neutral. The pH levels in the effluents of the various filters are shown graphically in Figures C-147 through C-156. Summarized in Table 5-31 for each media tested are the average filter column effluent pH, the net change from the influent pH and the average change for the column pair.

Filtration using #4 limestone sand increased the pH of the storm water by an average (n = 14) of 0.52 pH units. A net increase of approximately 0.3 pH units was observed in the filters containing the 28x48 mesh activated alumina, both existing and new media. Little change in pH was measured using the Bayoxide E-33, coarse mesh activated alumina, Superior 30 sand or the existing F-105 sand media. Both iron-modified activated alumina and the GFH decreased the pH of the settled storm water. Filtration with iron-modified activated alumina decreased the average pH by 0.93 pH units when the media was new and the bed depth was 24 inches. In the last two experimental runs, when the bed depth was 12 inches, the net decrease in pH value dropped to 0.55; however, the influent pH was slightly higher at that point. The GFH media decreased the pH by an average (n = 14) of 2.1 pH units. The average effluent pH of the GFH filters was between 5.3 and 5.4, which is below the Basin Plan objective of 6.5.

Table 5-31. Summary of Net Change in pH of the various 4-Inch Filter Media Evaluated in Phase IV

Media	Column #	Runs	Avg pH[a]	Change[b]	Avg Change
Limestone	11	18-24	8.02	0.53	0.52
	12	18-24	7.98	0.50	
AA (28x48)	5	18-24	7.79	0.31	0.30
	6	18-24	7.78	0.30	
Existing AA (28x48)	1	18-24	7.78	0.30	0.27
	2	18-24	7.72	0.24	
Bayoxide E-33	17	18-24	7.54	0.05	0.09
	18	18-24	7.60	0.12	
AA (14x28)	7	18-24	7.53	0.04	0.04
	8	18-24	7.52	0.04	
Superior 30	9	18-24	7.27	-0.22	-0.19
	10	18-24	7.31	-0.17	
Existing F-105 Sand	3	18-24	7.26	-0.22	-0.21
	4	18-24	7.29	-0.20	
Fe-Mod AA	13	23-24	6.93	-0.55	-0.55
	14	23-24	6.93	-0.55	
	13	18-24	6.63	-0.85	-0.85
	14	18-24	6.64	-0.84	
	13	18-22	6.55	-0.93	-0.93
	14	18-22	6.56	-0.92	
GFH	15	18-24	5.37	-2.11	-2.14
	16	18-24	5.31	-2.17	

[a] Average of the –Log [H^+ ions]
[b] Net increase or decrease in pH via filtration

Alkalinity

Effluent alkalinity concentrations of the various filters are presented in Figures C-147 through C-156. As expected, media that increase pH increase alkalinity and vice versa. Filtration with limestone increased the alkalinity by an average of 26 mg-$CaCO_3$/L. Filtration using the existing 28x48 mesh activated alumina increased the alkalinity by approximately 8.3 mg-$CaCO_3$/L. In Phase III, that same column pair was observed to increase the alkalinity of the storm water being filtered by an average of 11 mg-$CaCO_3$/L. The new 28x48 mesh activated alumina increased the storm water alkalinity by only 6.7 mg-$CaCO_3$/L.

Both GFH and iron-modified activated alumina decreased alkalinity of the storm water filtered. The iron-modified activated alumina decreased the alkalinity by an average (n = 7) of 21.6 mg-$CaCO_3$/L (average effluent alkalinity = 11.5 mg-$CaCO_3$/L). The GFH media depressed the pH of the storm water over 2 pH units and produced an effluent with only 1.5 mg-$CaCO_3$/L of alkalinity, an average decrease of approximately 31.6 mg-$CaCO_3$/L.

5.2.11 Limestone Polishing Column

Following Run 19, a small 4-inch diameter filter column containing 12 inches of #4 limestone sand was used to polish the effluent from Column 6 that contained new 28x48 mesh activated alumina media (see Section 3.2.1). Effluent from the limestone polishing column was monitored for pH, turbidity and dissolved aluminum. In five runs, the limestone polishing column further reduced the turbidity by an average of 2.7 NTU and increased the pH by an average of 0.6 pH units. Perhaps within measurement errors, the effluent from the limestone polishing column contained an average of 20 μg/L of additional dissolved aluminum.

5.2.12 Evaluation of Filter Loading Conditions

For each run, the mass (in mg) of a particular contaminant applied to each filter can be calculated by multiplying the run average clarifier effluent concentration (in mg/L) by the volume (in L) of storm water applied to the same filter. The total mass applied over the entire study can be calculated by summing the various mass values for each of the runs. Since some of the filters were out of service at times, the mass loadings varied accordingly.

Actual constituent mass loadings applied to the filters can be compared to full-scale equivalent annual loadings, which are calculated by multiplying the full-scale equivalent annual volume (equal to a 90 ft depth of water applied) by the "typical" Tahoe Basin storm water concentrations for the same constituents (see Table 4-2). Load comparisons developed on this basis are shown in Table 5-32. Also indicated in Table 5-32 are the maximum possible number of years of full-scale operation represented by the constituent loads applied during this study (if a unit was in service all 46 days). Note that since turbidity is not measured in mass per volume units, turbidity loading data indicated in Table 5-32 and in the figures discussed later in this section were calculated by multiplying turbidity in NTU by the depth of water applied in feet.

As can be seen in Table 5-32, assuming a loading of 90 ft/year (ft^3/ft^2 filter area per year), the maximum possible project hydraulic load to any one filter column was equivalent to a little less than 6 years of full-scale operation. With the exception of dissolved phosphorus, the maximum possible 4-inch column constituent loadings are lower than 6 years of full scale operation because of the relatively low concentrations in the influent storm water used. Loadings used in the 4-inch column filter runs simulated between 0.96 and 10.6 years of operation in the field, depending on constituent. The proportionately large dissolved phosphorus load was due to the fact that the storm water was spiked with dissolved phosphorus to supplement low raw storm water concentrations.

Actual project loadings to each of the filter columns were generally less than the maximum possible loadings (listed in Table 5-32), because none of the 4-inch filter columns were operated continuously for the full 46 days; although a few of the columns were only out of service for a few hours. Actual loadings for turbidity and phosphorus applied to the various columns are illustrated in the figures referenced below. Loading values calculated for each of the 18 columns are presented in Tables B-2 through B-19 (Appendix B).

Table 5-32. Calculated Hydraulic and Constituent Mass Loadings to the 4-Inch Filter Columns Compared to Full-Scale Equivalent Annual Loadings

Parameter	Units	Maximum Possible 4-Inch Column Loading This Study[a]	Full-Scale Equivalent Annual Loading[b]	Number of Years Represented This Study
Hydraulic Load	ft	535	90[c]	5.9
Turbidity	NTU-ft	160,135	42,930	3.7
Total Suspended Solids	Grams	194	168	1.2
Total Kjeldahl Nitrogen	Grams	1.32	0.53	2.5
Total Phosphorus	Grams	0.46	0.48	0.96
Dissolved Phosphorus	Grams	0.17	0.016	10.6

[a] Calculated based on the average clarifier effluent constituent concentrations multiplied by volume of water filtered for that run and the summed for the study. Constituent concentrations below the reporting limit were assumed to be equal to ½ of the reporting limit.

[b] Based on annual equivalent volume for 4-inch filter columns of 222 L (based on 90 ft depth applied) multiplied by typical Tahoe Basin constituent concentrations. Typical concentrations were assumed to be the mean EMC values from the *Caltrans Tahoe Highway Runoff Characterization and Sand Trap Effectiveness Studies, 2000-03 Monitoring Season*, CSTW-RT-03-054.36.02 (Caltrans, 2003e).

Long-term filter performance in the removal of specific constituents can be evaluated by examining the cumulative load applied versus the cumulative load removed. Load-removed versus load-applied curves can be used to determine if and when the treatment capacity of a filter for a particular constituent has been reduced or exhausted. In such cases, the ability to remove that contaminant will decrease, causing the curve to level off (minimal load removed with additional load applied). Although this type of assessment is most suitable for the analysis of dissolved constituents by adsorption, it can also be used to indicate decreased treatment performance when other removal mechanisms are active, either alone or in combination with adsorptive processes. In the following paragraphs load-removed versus load-applied evaluations for turbidity, total suspended solids and total and dissolved phosphorus are discussed. It is believed that removals are by a combination of physical and adsorptive processes.

A series of loading diagrams are presented in Appendix C for both Phase IV (Figures C-215 through C-268) and Phase III filter effluents (Figure C-269 through C-284). Loading results are discussed by parameter in the following sections.

Turbidity Loading

A separate graph of the turbidity load removed versus turbidity load applied for all 18 filter columns is included in Appendix C, Figures C-197 through C-214. Only the column effluent turbidities are plotted on the loading figures. An example Turbidity Load Removed vs. Load Applied graph is shown in Figure 5-6. A dashed line indicates load removed = load applied. Vertical lines are placed at the transition between runs (or storm waters), starting at Run 18 and progressing through Run 24. A blue line near the x-axis indicates that the sand cap was replaced at that point of the loading. Similarly, a red line indicates that the sand cap and the upper media layer were replaced.

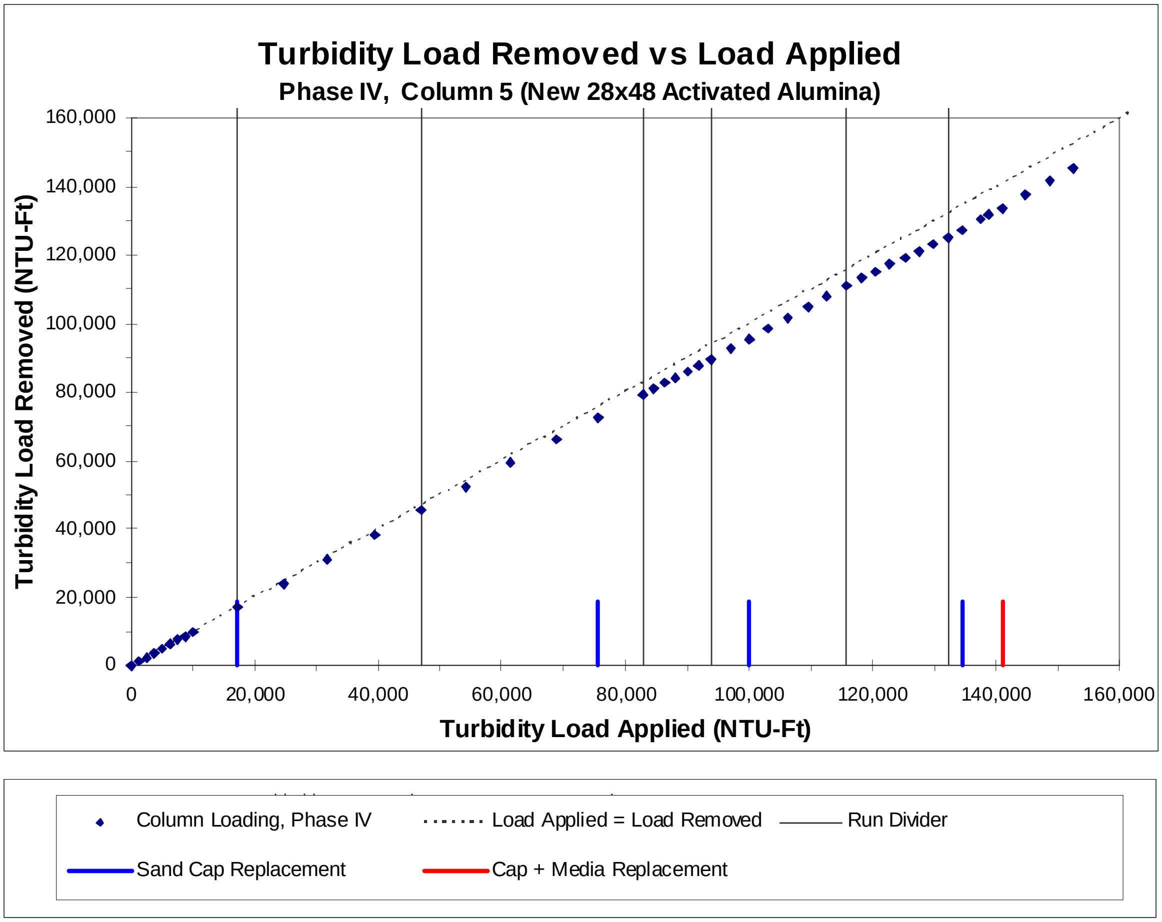


Figure 5-6. Example Turbidity Load Removed vs. Load Applied Graph

Based on analysis of the load removed vs. load applied graphs in the figures in Appendix C, the DD-2 activated alumina media (existing 28x48 mesh, new 28x48 mesh, and 14x28 mesh), as well as the GFH show no decrease in the ability to remove turbidity over the length of the study (curve slopes did not decrease). The lines of load removed vs. load applied for Columns 7 and 8 (14x28 mesh AA) indicate that the removal of turbidity is not as good as that observed with the finer grained material, but the capacity for removal did not decrease over the study.

The existing F-105 sand in Columns 3 and 4 may have approached its capacity to remove turbidity as evidenced by the decreasing slope of the load curves (Figures C-217 and C-218). The graphs of the load applied vs. load removed for Columns 9 and 10 that contained Superior 30 sand (Figures C-223 and C-224) clearly illustrate a difference in performance for the replicate media columns; however, the capacity to remove turbidity did not diminish over the length of the study in either filter (slope remained about the same). As observed with the F-105 sand, the limestone filters (Columns 11 and 12) may have reached a point of diminished capacity as evidenced by the reduced slope of the curves in the latter runs.

The iron-modified activated alumina filters (Columns 13 and 14, Figures C-227 and C-228) were removing nearly 100 percent of the turbidity applied for the first five runs. After the removal of the upper 12 inches of media, the filter's capacity to remove turbidity began to decrease. The Bayoxide E-33 media in Column 17 showed no sign of diminishing capacity to remove turbidity over the duration of the study, whereas some diminished capacity was apparent for Column 18 in the last run (Figures C-231 and C-232).

A further analysis of the existing activated alumina (28x48 mesh) in Columns 1 and 2 and the F-105 sand media in Columns 4 and 5 can be made by analyzing total cumulative load removed versus load applied for Phases III and IV (see Figures C-269 and C-270 for the activated alumina and Figures C-271 and C-272 for the F-105 sand). After two seasons of pilot operations (approximately 12 years of simulated field operation), there is clearly no diminished capacity of the activated alumina to remove turbidity; although frequent intervention was required to maintain flow. For the F-105 sand, however, a diminishing capacity to remove turbidity is apparent.

Each of the filters required some sort of intervention to maintain flow through the media bed over the duration of the study (either a sand cap or sand cap and some amount of media required replacement). The average amount of turbidity loaded to a filter (in NTU-ft) between interventions can be calculated by summing the load applied between interventions and taking the average of those sums. As can be seen in Table 5-33, this average load between interventions can be compared to the typical Tahoe Basin annual turbidity load to a filter of 42,930 NTU-ft. The average turbidity load applied at hydraulic failure does not reflect the fact that certain media were not particularly effective in removing the turbidity, but is useful in drawing loading comparisons between media.

Table 5-33. Calculated Turbidity Load at Hydraulic Failure

Column	Media	Number of Interventions Total# (Cap/Cap+Media)	Avg. Turbidity Load at Failure (NTU-ft)	Number of Years[a] Represented
7 & 8	Activated Alumina (14x28)	5 (5/0)	51,640	1.2
3 & 4	Existing F-105 Sand	5 (5/0)	46,160	1.1
11 & 12	Limestone	5 (5/0)	42,198	0.98
9 & 10	Superior 30	6 (6/0)	39,999	0.93
17 & 18	Bayoxide	8 (7/1)	35,289	0.82
5 & 6	Activated Alumina (28x48)	11 (8/3)	23,542	0.55
15 & 16	GFH	12 (8/4)	23,066	0.54
1 & 2	Existing AA (28x48)	16 (10/6)	16,724	0.39
13 & 14	Fe-Mod AA[b]	13 (7/6)	15,173	0.35

[a] Based on annual equivalent volume for filters (90 ft) multiplied by the typical Tahoe Basin turbidity of 477 NTU (Caltrans, 2003e).

[b] Runs 18-23, when operated at a bed depth of 24 inches.

The media that were most effective in turbidity removal (see Table 5-21) generally failed after a relatively small expected annual Tahoe Basin turbidity load was applied. The exception is the

14x28 mesh activated alumina that removed a respectable 89.2 percent of the turbidity and operated a simulated 1.2 years between interventions.

Total Suspended Solids Loading

Total suspended solids load removed versus TSS load applied graphs for the 18 filter columns are included in Appendix C (Figures C-215 through C-232).

As observed with turbidity, the DD-2 activated alumina media (existing 28x48 mesh, new 28x48 mesh, and 14x28 mesh) as well as the GFH showed no decrease in the ability to remove TSS over the duration of the study. For the 14x28 mesh activated alumina, the removal of suspended solids is not as good as that observed with the finer grained activated alumina media, but the capacity for removal is steady.

As observed with turbidity, the existing F-105 sand in Columns 3 and 4 may have approached its capacity to remove TSS, as evidenced by the slight rounding off of the loading curves (Figures C-217 and C-218). One of the Superior 30 sand filters also exhibited some diminished capacity for TSS removal (Column 9, Figure C-223) while its replicate did not (Figure C-234). The limestone filter columns were showing a diminished capacity for turbidity removal but not for TSS (Figures C-225 and C-226).

As with turbidity, the iron-modified activated alumina filters (Columns 13 and 14, Figures C-227 and C-228) were removing nearly 100 percent of the TSS applied for the first five runs and after the upper 12 inches of media were removed, the filters' capacity to remove solids began to decrease slightly. Although the Bayoxide media in Column 18 seemed to perform somewhat better on TSS removal than that in Column 17 during most of the study, some hint of diminishing capacity to remove TSS was apparent in Column 18 near the end of the study (Figures C-231 and C-232).

Examining the cumulative (Phase III + Phase III) TSS loading graphs for Columns 1 and 2 (28x48 mesh activated alumina, Figures C-273 through C-276); there is no indication of diminishing capacity for TSS removal. From the Phase III and IV TSS loading graphs for the F-105 sand (Columns 3 and 4, Figures C-275 and C-276), a slight decrease in TSS removal capacity is apparent near the end of the study.

The "typical" Tahoe Basin storm water TSS concentration is 759 mg/L (Caltrans, 2003e). In this study, the average (n = 7) TSS concentration was 371 mg/L. Storm water used at the Pilot Facility was collected from basins and roadside boxes where the larger suspended material had opportunity to settle out. The TSS concentration in the raw water collected decreased to 158 mg/L after clarification. The hydraulic load applied to the filters simulated 5.9 years of "typical" Tahoe loading, but because of the relatively low TSS content of the clarified storm water applied to the columns, only 1.2 years of "typical" Tahoe Basin TSS load was applied. Summarized in Table 5-34 are the average TSS loads applied to the columns at failure.

Table 5-34. Calculated TSS Load at Hydraulic Failure

Column	Media	Number of Interventions Total# (Cap/Cap+Media)	Avg. TSS Load at Failure (grams)	Number of Years[a] Represented
7 and 8	Activated Alumina (14x28)	5 (5/0)	60.8	0.36
3 and 4	Existing F-105 Sand	5 (5/0)	55.9	0.33
9 and 10	Superior 30	6 (6/0)	48.4	0.29
11 and 12	Limestone	5 (5/0)	48.1	0.29
17 and 18	Bayoxide	8 (7/1)	42.7	0.25
5 and 6	Activated Alumina (28x48)	11 (8/3)	28.5	0.17
15 and 16	GFH	12 (8/4)	28.0	0.17
1 and 2	Existing AA (28x48)	16 (10/6)	20.3	0.12
13 and 14	Fe-Mod AA[b]	13 (7/6)	17.3	0.10

[a] Based on annual equivalent volume for filters (4-inch, 222L at 90 ft/yr) multiplied by the typical Tahoe Basin TSS concentration of 759 NTU = 168 g/year (Caltrans, 2003e).

[b] Runs 18-23, when operated at a bed depth of 24 inches

An average of approximately 61 g of TSS (0.36 years of simulated annual load) was applied to the 14x28 mesh activated alumina filters (each) prior to each of the hydraulic failures. This media removed an average of 94.2 percent of the applied TSS (see Table 5-24). The finer mesh activated alumina removed an average of 96.1 percent of the TSS applied but failed hydraulically after 0.17 years of simulated Tahoe Basin TSS load. In general, filters that removed a larger percentage of the TSS load failed comparatively faster than filters removing a smaller percentage, with the exception of the 14x28 mesh activated alumina, which had a relatively high percent removal and a relatively high load to failure.

Total Phosphorus Loading

Total phosphorus removed versus Phos-T load applied graphs for the 18 filter columns are included in Appendix C (Figures C-233 through C-250). Based on the loading graphs, the DD-2 activated alumina media (existing 28x48 mesh, new 28x48 mesh, and 14x28 mesh) as well as the GFH showed no decrease in the ability to remove total phosphorus from the storm water over the duration of this study. In all graphs, there was a slight leveling off of the Phos-T removed during Experimental Run 22, perhaps due to an overestimation of the clarifier Phos-T concentration.

There is a definite decrease in slope beginning in Run 22 for the Phos-T loading curves for the existing F-105 sand (Columns 3 and 4, Figures C-235 and C-236), indicating that the capacity to remove Phos-T was diminished. Curves for the other filter sand media (Superior 30, Figures C-241 and C-242) and for the limestone media (Figures C-243 and C-244) exhibit a similar pattern.

Other than a minor leveling observed in Run 22, the iron-modified activated alumina filters (Columns 13 and 14, Figures C-245 and C-246) demonstrated continued ability to remove phosphorus at a 12 inch or 24 inch media depth. The Bayoxide E-33 media (Columns 17 and 18, Figures C-249 and C250) continued to remove Phos-T at a relatively constant rate through the end of the study, except that the removal was somewhat diminished during Run 22.

From the cumulative Phase III and Phase III Phos-T loading graphs for Columns 1-4 (28x48 mesh activated alumina in Columns 1 and 2, Figures C-277 and C-278 and the F-105 sand in Columns 3 and 4, Figures C-279 and C-280), there is no indication of diminishing capacity for the activated alumina media, but there is a substantial decrease in the Phos-T removal capacity for the F-105 sand media, beginning at Run 22.

During the Phase IV operation, 5.9 years of hydraulic loading through each filter was simulated, but the water contained less phosphorus than typically measured in Tahoe Basin storm water. As a result, only 1 year (0.96 years, see Table 5-32) of simulated Tahoe Phos-T load was applied to each of the filters. Summarized in Table 5-35 are the average total phosphorus loads applied to the columns at failure and the number of years of "typical" load represented.

The F-105 sand went 0.28 years of simulated phosphorus loading between interventions; however, this media removed only 63.4 percent of the Phos-T from the storm water (see Table 5-23). The 14x28 mesh activated alumina removed approximately 92.4 percent of the Phos-T and lasted 0.26 years of simulated loading between interventions. Other than the 14x28 mesh activated alumina, filters that removed a larger percent of the Phos-T load applied failed comparatively faster. It is likely that hydraulic failures are related to TSS loadings and removals and that any correlation to Phos-T removal is due to the removal of particulate associated phosphorus.

Table 5-35. Calculated Phos-T Load at Hydraulic Failure

Column	Media	Number of Interventions Total# (Cap/Cap+Media)	Avg. Phos-T Load at Failure (grams)	Number of Years[a] Represented
3 and 4	Existing F-105 Sand	5 (5/0)	0.132	0.28
7 and 8	Activated Alumina (14x28)	5 (5/0)	0.126	0.26
9 and 10	Superior 30	6 (6/0)	0.114	0.24
11 and 12	Limestone	5 (5/0)	0.095	0.20
17 and 18	Bayoxide	8 (7/1)	0.092	0.19
5 and 6	Activated Alumina (28x48)	11 (8/3)	0.066	0.14
15 and 16	GFH	12 (8/4)	0.061	0.13
1 and 2	Existing AA (28x48)	16 (10/6)	0.045	0.09
13 and 14	Fe-Mod AA[b]	13 (7/6)	0.034	0.07

[a] Based on annual equivalent volume for filters (4-inch, 222L at 90 ft/yr) multiplied by the typical Tahoe Basin Phos-T concentration of 2.14 mg-P/L NTU = 0.475 g/year (Caltrans, 2003e).

[b] Runs 18-23, when operated at a bed depth of 24"

Dissolved Phosphorus Loading

The average Phos-D concentration in the first 4 runs was less than the reporting limit of 0.03 mg-P/L. In the last three runs of the study the raw water was spiked with sodium phosphate. As a result, the average Phos-D concentration of the clarified storm water in Runs 22, 23 and 24 was 0.25 mg-P/L. Phos-D load removed versus Phos-D load applied graphs are shown in Appendix C (Figures C-251 through C-268). The horizontal lines that separate the experimental runs are bunched tightly for the first 4 runs where little Phos-T load was present.

Based on the loading graph, the removal performance of Column 1 (existing activated alumina) was diminished in Runs 21 and 22, but then performance improved and remained steady in Runs 23 and 24 (Figure C-251). This may be an artifact of the low phosphorus levels, short-circuiting or measurement error. The other existing activated alumina column (Column 2) performed quite differently, with relatively stable removal of Phos-D throughout Phase IV (Figure C-252). Both of the new activated alumina media (14x28 and 28x48 mesh) and the GFH showed reduced ability to remove Phos-D during Run 22 (Figures C-255 through C-258, and C-265 and C-266)

From the Phos-D loading curves for the existing F-105 sand (Columns 3 and 4, Figures C-253 and C-254), it is clear that the media has little ability to remove Phos-D. In the first 4 runs the load removed is close to the load applied because ½ of the reporting limit was used for both load summations, giving the appearance that some dissolved phosphorus was actually being applied and removed. When Phos-D was present in the influent (Runs 22, 23 and 24) the media was generally unable to remove substantial amounts of the load. The other sand media (Superior 30, Figures C-259 and C-260) and the limestone media (Figures C-261 and C-262) performed similarly.

As observed with total phosphorus, other than the minor leveling observed in Run 22, the iron-modified activated alumina filters (Columns 13 and 14, Figures C-263 and C-264) demonstrated continued ability to remove dissolved phosphorus with a bed depth of 12 inches or 24 inches. The Bayoxide E-33 media (Columns 17 and 18, Figures C-267 and C268) also continued to remove Phos-T at a steady rate through the end of the study, except for Run 22.

From the cumulative Phase III and Phase IV Phos-T loading graphs for Columns 1 and 2 (the 28x48 mesh activated alumina, Figures C-281 and C-282) the level spot on the loading graph at Run 22 is the only discontinuity in an otherwise straight line. The F-105 sand Phos-D loading graphs in Figures C-283 and C-284 show that the media was unable to remove dissolved phosphorus in both phases of project activities.

Only the last three experimental runs in Phase IV had any substantial amount of dissolved phosphorus. During the Phase IV operation, 5.9 years of hydraulic load through each filter was simulated but, because of Runs 22, 23, and 24 being spiked with Phos-D, the simulated Phos-D loading was approximately 10.6 years of equivalent full-scale operation (Table 5-32). Summarized in Table 5-36 are the average dissolved phosphorus loads applied to the columns at the time of failure and the number of years of “typical” load represented at failure.

The analysis of the average amount of Phos-D loading at failure was very run dependent. Columns that failed frequently during the first four experimental runs had very low calculated

Phos-D loads at failure. Columns that failed infrequently in the last three experimental runs had larger Phos-D load values at failure. In general, hydraulic failure is expected to be a function of TSS loadings and removals, which would not necessarily be correlated to dissolved phosphorus loadings or removals, especially with the spiking of dissolved phosphorus as was practiced in Runs 22-24. Therefore, it is believed that there is no significance to the relative Phos-D loadings at hydraulic failure indicated in Table 5-36.

Table 5-36. Calculated Phos-D Load at Hydraulic Failure

Column	Media	Number of Interventions Total# (Cap/Cap+Media)	Avg. Phos-D Load at Failure (grams)	Number of Years[a] Represented
3 and 4	Existing F-105 Sand	5 (5/0)	0.049	3.0
9 and 10	Superior 30	6 (6/0)	0.042	2.6
7 and 8	Activated Alumina (14x28)	5 (5/0)	0.028	1.8
17 and 18	Bayoxide	8 (7/1)	0.028	1.8
5 and 6	Activated Alumina (28x48)	11 (8/3)	0.023	1.5
15 and 16	GFH	12 (8/4)	0.020	1.2
1 and 2	Existing AA (28x48)	16 (10/6)	0.015	0.9
11 and 12	Limestone	5 (5/0)	0.010	0.6
13 and 14	Fe-Mod AA[b]	13 (7/6)	0.004	0.3

[a] Based on annual equivalent volume for filters (4-inch, 222L at 90 ft/yr) multiplied by the typical Tahoe Basin Phos-T concentration of 2.14 mg-P/L NTU = 0.475 g/year (Caltrans, 2003e).

[b] Runs 18-23, when operated with a bed depth of 24 inches

5.2.13 12-Inch Media Depth Samples

Samples for turbidity and phosphorus (total and dissolved) were collected at a bed depth of 12 inches (half way down the media bed) at the time of effluent sample collection for the 4-inch columns. Analysis of the removal at two depths can provide insight as to where in the column the majority of the constituent is removed. Summarized in Table 5-37 are the average ($n = 14$ [replicate columns, 7 experimental runs]) percent removals for turbidity and total phosphorus at the 12-inch and 24-inch depths. Also listed in Table 5-37 are the average ($n = 8$) percent removals for the 12-inch and 24-inch depth samples when dissolved phosphorus was present in the influent at concentrations greater than the reporting limit. Because of the removal of the upper 12 inches of iron-modified activated alumina after Run 22, there was insufficient data to calculate the percent removal at the 12-inch depth. Complete results of the 12-inch and 24-inch depth samples are included in Appendix B.

As can be seen in Table 5-37, for almost every media there were substantial additional pollutant removals between the 12- and 24-inch depths. For the three DD-2 activated alumina media (existing 28x48, new 28x48 and 14x28), a 7-19 percent improvement in turbidity reduction, 6-41 percent improvement in total phosphorus removal and 0-7 percent improvement in dissolved phosphorus removal were attained. However, the improvements observed in the percent removal of turbidity and total phosphorus for the iron-modified activated alumina were quite small, indicating that the majority of removal was being performed in the upper 12 inches. Improved performance (6-18 percent) with depth was also observed in the sand media (Superior 30 and the existing F-105 sand). For limestone, Bayoxide and the GFH, a 10-20 percent improvement with depth was typically realized, with a few exceptions.

Table 5-37. Calculated Percent Removals at 12-Inch and 24-Inch Depth

Column #	Media	Depth	Percent Removal		
			Turbidity	Phos-T	Phos-D
1 and 2	Existing AA	12"	89.9	83.7	90.2
		24"	96.6	96.6	90.2
3 and 4	Existing F-105 Sand	12"	61.5	45.7	15.6
		24"	74.2	63.4	25.7
5 and 6	28x48 mesh AA	12"	83.9	89.3	76.3
		24"	95.6	95.5	83.0
7 and 8	14x28 mesh AA	12"	70.5	51.0	80.4
		24"	89.2	92.4	83.9
9 and 10	Superior 30 Sand	12"	61.1	46.0	32.3
		24"	72.8	62.1	38.0
11 and 12	Limestone	12"	65.3	41.2	24.2
		24"	74.6	60.0	26.2
13 and 14	Fe-Mod AA	12"	97.0	90.1	[a]
		24"	99.7	90.7	86.6
15 and 16	GFH	12"	81.5	92.4	74.6
		24"	96.3	88.2	82.1
17 and 18	Bayoxide E-33	12"	74.5	73.2	65.2
		24"	86.2	88.4	83.0

[a] Insufficient data

5.2.14 Comparison of Media and Effectiveness

Three major considerations in evaluating media performance are: 1) effectiveness in removing constituents of concern, 2) hydraulic performance, and 3) undesirable side effects, such as an increase in dissolved aluminum concentration or pH. These three considerations are discussed in this section.

Media Effectiveness in Contaminant Removal

Media effectiveness can be evaluated by examining the average effluent concentration over the seven run study. Secondly, the effectiveness of a media in contaminant removal can be evaluated by calculating the average percent removal of a particular constituent (useful from a TMDL standpoint). Finally, an evaluation of the ability to produce an effluent that complies with the numerical limits for surface water discharge is important. Summarized in Table 5-38 are the data from the 4-inch filter column runs evaluated from these three perspectives.

As can be seen from the data summarized in Table 5-38, the media with the lowest effluent concentration often has the highest percent removal and the best compliance with the Tahoe Basin surface water discharge limits, with a few exceptions. Based on each of the three water quality parameters evaluated in Table 5-38 (turbidity, total phosphorus and total nitrogen), media performance can be assigned a ranking based on percent removal (1 being the best percent removal, 11 being worst). To determine the best overall performing media (relative to each other) the rankings can then be averaged. An alternative to this approach is to simply take an average of the average percent removals. Summarized in Table 5-39 are the individual performance rankings for turbidity, total phosphorus and total nitrogen removal. Also listed in Table 5-39 is the average rank and the average of the average percent removals. Notice that the iron-modified activated alumina ranking is divided into three parts, reflecting the various runs and media depths.

Iron-modified activated alumina, when operated at a bed depth of 24 inches (Runs 18-22) has the highest overall ranking of the media tested (and the greatest average percent removal). The second best performing media with respect to turbidity, total phosphorus and total nitrogen removal was the 28x48 mesh activated alumina, regardless of its relative age (Phase III or Phase IV media). The larger grain size activated alumina (14x28 mesh) was fourth in the parameter ranking, but had the second highest overall percent removal. The two sand media and the limestone, while still removing above 60 percent of the average constituents listed in Table 5-39, rank at the bottom for overall performance.

Hydraulic Performance

The amount of loading that a filter can sustain before developing excessive head loss and requiring maintenance to restore flow is a key issue in evaluating the filter media. In this regard, it is important, not to look just at the volume of storm water handled, but also to consider the quality of the storm water. A filter will be able to handle a higher volume of relatively clean storm water than relatively dirty storm water. It is believed that the most important constituent loadings to be considered with regard to hydraulic performance are the turbidity and TSS loadings. As turbidity and/or TSS are applied and removed in a filter, the filter becomes clogged and head loss is increased. In Table 5-40, the equivalent annual full-scale hydraulic, turbidity, and TSS loadings handled by the filters between interventions to restore flow are summarized. Although field performance and small-scale pilot performance may differ (actual hydraulic performance in the field is apparently better than predicted on small-scale), relative performance in the laboratory is probably a good indication of relative performance in the field. Ideally, full-scale filters should be able to operate at least three years without maintenance.

Table 5-38. Summary of 4-Inch Filter Column Water Quality Performance for Turbidity, Total Phos. and Total Nitrogen

Media	Columns	Run	Turbidity			Total Phosphorus			Total Nitrogen		
			Avg. Eff Conc. (NTU)	Avg. % Removal	Meets Surface Water Limits	Avg. Eff Conc. (NTU)	Avg. % Removal	Meets Surface Water Limit	Avg. Eff Conc. (NTU)	Avg. % Removal	Meets Surface Water Limits
Existing AA	1 & 2	All	7.2	96.6	13 of 14	<0.03	96.6	13 of 14	0.27	62.3	12 of 14
Existing F-105 Sand	3 & 4	All	82.5	74.2	0 of 14	0.15	63.4	7 of 14	0.31	71.2	13 of 14
AA (28x48)	5 & 6	All	12.4	95.6	9 of 14	<0.03	65.5	13 of 14	0.27	65.1	11 of 14
AA (14x28)	7 & 8	All	37.0	89.2	6 of 14	0.04	92.4	14 of 14	0.25	76.8	13 of 14
Superior 30 Sand	9 & 10	All	88.7	72.8	0 of 14	0.16	62.1	6 of 14	0.47	49.2	9 of 14
Limestone	11 & 12	All	84.2	74.6	0 of 14	0.16	60.0	7 of 14	0.43	53.8	11 of 14
Fe-Mod AA	13 & 14	18-22	0.7	99.7	10 of 10	<0.03	90.7	9 of 10	0.18	87.7	10 of 10
Fe-Mod AA	13 & 14	23-24	18.4	93.2	0 of 4	<0.03	100	4 of 4	0.46	7.0	2 of 4
Fe-Mod AA	13 & 14	All	62.8	76.9	10 of 14	<0.03	93.4	13 of 14	0.26	64.7	12 of 14
GFH	15 & 16	All	8.1	96.3	12 of 14	0.05	88.2	12 of 14	0.41	43.3	9 of 14
Bayoxide	17 & 18	All	51.3	86.2	5 of 14	0.05	88.4	12 of 14	0.42	51.6	10 of 14

Table 5-39. Ranking of Media Effectiveness in Contaminant Removal in the Phase IV 4-Inch Filter Columns

Media	Columns	Runs	Individual Parameter Ranking			Avg. Rank	Avg. %Removal
			Turb	Phos	Tot-N		
Fe-Mod AA	13 & 14	18-22	1	6	1	2.67	92.7
Existing AA (28x48)	1 & 2	18-24	2	2	6	3.33	85.2
AA (28x48)	5 & 6	18-24	4	3	4	3.67	85.4
AA (14x28)	7 & 8	18-24	6	5	2	4.33	86.1
Fe-Mod AA	13 & 14	18-24	8	4	5	5.67	78.3
Fe-Mod AA	13 & 14	23-24	5	1	11	5.67	66.7
GFH	15 & 16	18-24	3	8	10	7.00	75.9
Bayoxide	17 & 18	18-24	7	7	8	7.33	75.4
Existing F-105 Sand	3 & 4	18-24	10	9	3	7.33	69.6
Limestone	11 & 12	18-24	9	11	7	9.00	62.8
Superior 30 Sand	9 & 10	18-24	11	10	9	10.0	61.4

Table 5-40. Hydraulic Ranking of the various 4-Inch Column Media (Phase IV)

Rank	Media	Number Interventions	Ft Filtered Between Interventions	Load as Equivalent Years of Full Scale Operation Between Interventionist		
				Hydraulic	Turbidity	TSS
1	AA (14x48)	5	165	1.8	1.2	0.36
2	F-105 Sand [2]	5	163	1.8	1.1	0.33
3	Limestone	5	127	1.4	0.98	0.29
4	Superior 30	6	101	1.1	0.93	0.29
5	Bayoxide	8	118	1.3	0.82	0.25
6	AA (28x48)	11	95	1.1	0.55	0.17
7	GFH	12	78	0.9	0.54	0.17
8	Existing AA [2]	16	90	1.0	0.39	0.12
9	Fe-Mod. AA	19 [1]	50	0.6	0.35	0.10

[1] The number of interventions normalized to seven Phase IV experimental runs
[2] Phase IV data only

The best performing media from a hydraulic standpoint was the 14x28 mesh activated alumina, filtering slightly more water before sand cap replacement than the existing F-105 sand. Both media handled about 1.8 years of hydraulic loading before intervention. However, the turbidity and TSS loadings before intervention were equivalent to only 1.1 to 1.2 and 0.33 to 0.36 years of full-scale operation, respectively. As observed in Section 5.2.2, the finer grain activated alumina, the iron-modified activated alumina and the GFH required the most interventions to maintain flow and filtered the least amount of storm water between interventions.

Side Effects

The most commonly observed undesirable effects of media filtration are the increase in effluent pH and dissolved alumina. As discussed in Section 5.3.10, a net increase in pH of 0.3 units was observed in the effluent of the 28x48 mesh activated alumina. However, all effluents from the 28x48 mesh activated alumina had pH values within the objectives established for receiving waters by LRWQCB (6.5 – 8.5). Filtration with the coarse activated alumina (14x28 mesh) had essentially no effect on storm water pH level.

Filtration with the limestone media increased the storm water pH by an average of 0.5 pH units, and in one case, the effluent exceeded the upper objective of 8.5 (Column 11, Run 24 pH = 8.9). Both the iron-modified activated alumina and the GFH decreased the pH. Filtration with the iron-modified activated alumina decreased the pH by an average of 0.93 pH units. In two of 14 runs, the pH of the iron-modified activated alumina was below the receiving water objective of 6.5. The GFH media decreased the storm water pH by an average of approximately 2.1 units. The effluent pH of the GFH filters was consistently below 6.5.

As discussed in Section 5.3.9, effluent from the activated alumina, limestone and GFH filters increased dissolved aluminum levels. The new 28x48 mesh activated alumina filters increased dissolved aluminum levels by nearly 250% (average effluent concentration = 54 μg/L, which is slightly lower than the 83 μg/L observed in the similar media in Phase III). Filtration with the larger 14x28 mesh activated alumina increased effluent Al-D by 375 percent (average effluent concentration = 64 μg/L). For both media, most of the increase in effluent Al-D occurred in the first few experimental runs. The increase in effluent Al-D levels observed in the limestone filters was less significant (130 percent increase, with the average effluent concentration = 30 μg/L). Of significance is that an increase in Al-D concentration was not measured in the effluent from the existing activated alumina filters, perhaps indicating that dissolved aluminum levels will drop with use and age.

5.2.15 Turbidity Correlations

Because of the ease of measurement of turbidity, it would be useful if there was a good correlation between turbidity and other water quality parameters. Intuitively, there is a correlation between turbidity and TSS; however, there is no universal relationship between the two for storm water. Twelve different storm/snowmelt waters were collected in Phase III and eight more in this study (Phase IV). These data can be examined for relationships between TSS, total phosphorus and turbidity both before and after clarification.

Shown in Figure 5-7 is a graph of influent (raw storm water) TSS vs. turbidity for the Phase III and Phase IV storm water samples used at the Pilot Facility. Figure 5-8 contains a graph of TSS vs. turbidity of the clarifier effluent data for the two study periods. Although the exact relationship is unknown, the data sets in both figures are fitted with linear regression line with associated R^2 values. The linear regressions both have good R^2 values; however, there is a conspicuous absence of data in the middle ranges.

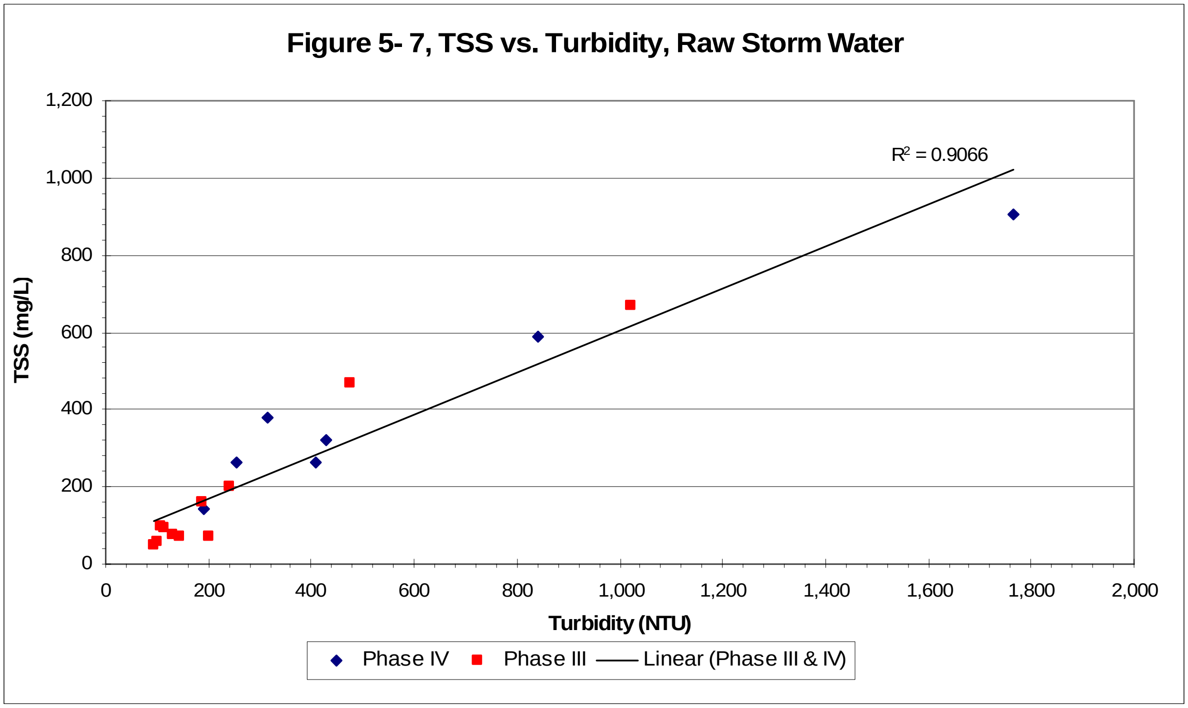


Figure 5-7. TSS vs. Turbidity Graph of the Phase III and IV Influent Storm Water

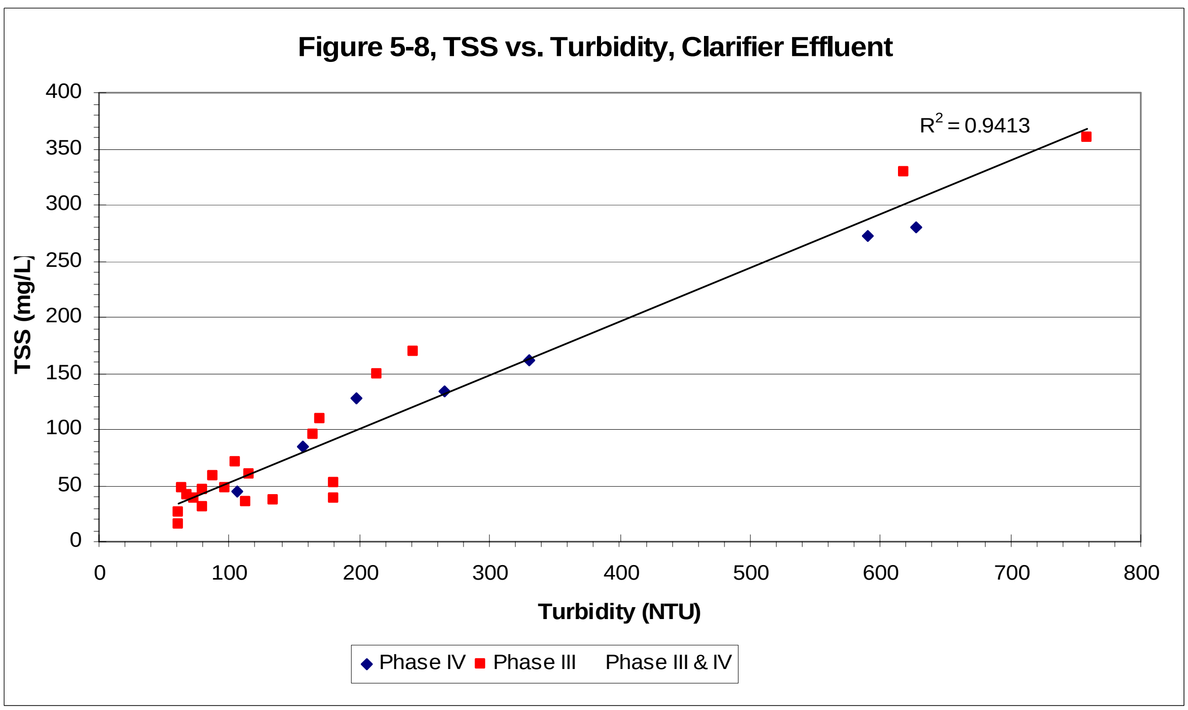


Figure 5-8. TSS vs. Turbidity Graph of the Clarifier Effluent Used in the 4-Inch Filter Column Runs, Phase III and IV

Correlations between turbidity and total phosphorus for the influent and clarifier effluent are presented in Figures 5-9 and 5-10. Neither data set has a high linear correlation (high R^2).

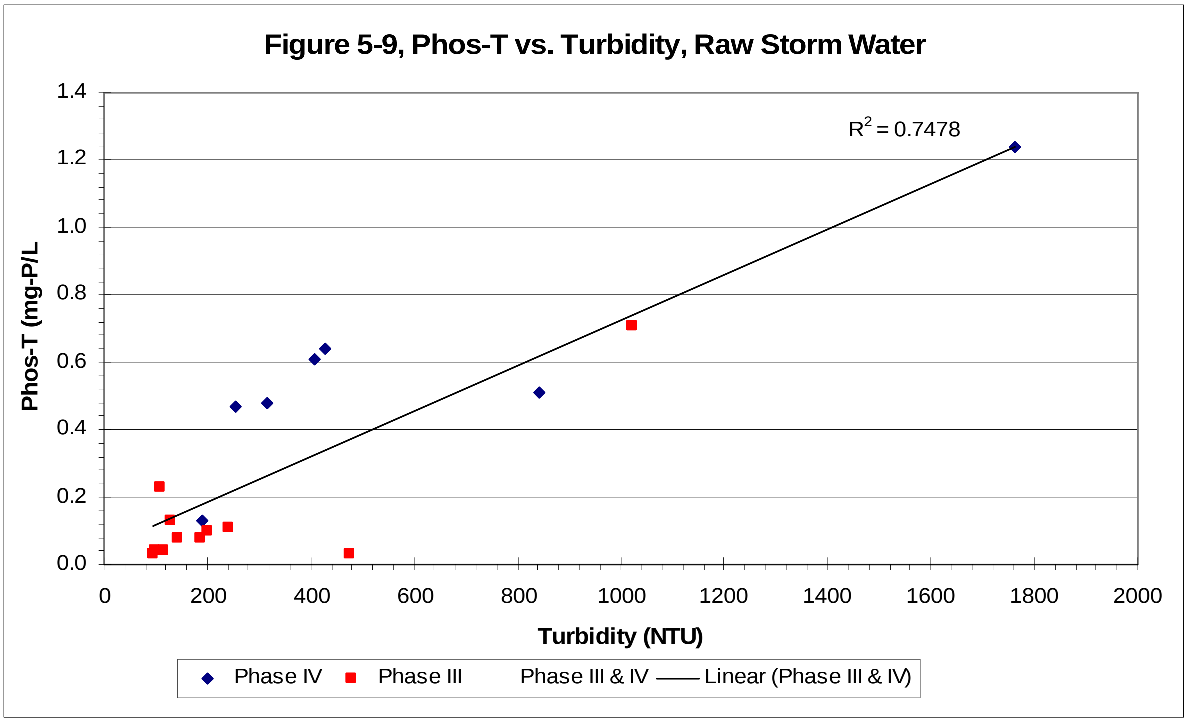


Figure 5-9. Total Phosphorus vs. Turbidity Graph of the Phase III and IV Influent Storm Water

5.3 Jar Test Experimental Results

For each batch of storm water collected, a series of jar-test experiments were conducted to determine the dose range of product effectiveness. Six chemicals (PASS-C, PAX-XL9, Jenchem 1720, SumalChlor 50, Superfloc A-100 and SoilFix IR) and three different jar test conditions (standard mixing, limited mixing, and colder water temperature) were evaluated. The apparent best chemical dose was determined by measuring the turbidity of the dosed storm water after mixing followed by 15 minutes of settling. After one hour of settling, turbidity was again measured and some jars were sampled for total and dissolved phosphorus analyses. Product literature for the chemicals used was provided in Appendix B of the M&O Plan.

The procedures used in this study were presented in Section 2.1.2 and Appendix A of the M&O Plan. The specific jar test conditions for the standard mixing, mixing sensitivity and temperature sensitivity tests were presented in Table 3-8. Results of the jar tests are presented in the following sections, arranged by mixing condition.

Because of the short jar test mixing conditions, results presented should not be interpreted as the best possible performance of the chemicals evaluated.

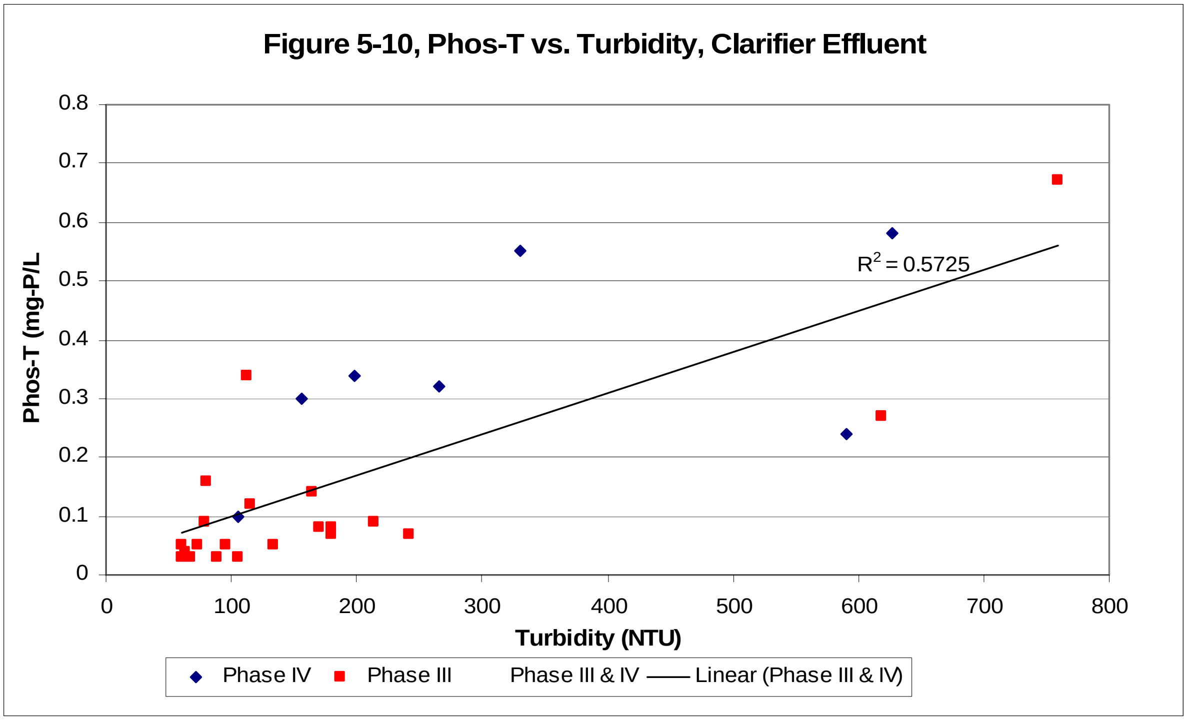


Figure 5-10. Total Phosphorus vs. Turbidity Graph of the Clarifier Effluent Used in the 4-Inch Filter Column Runs, Phase III and IV

5.3.1 Turbidity Removal Performance – Standard Mixing

The ability of each of the products tested to achieve a settled turbidity below the Tahoe Basin benchmark for discharge to surface water (20 NTU) varied with the storm waters tested. A summary of the water quality of the storm waters used was presented in Table 4-2. The Phase IV jar test data (turbidity and phosphorus) are included in Tables D-1 through D-43 in Appendix D. The results of all of the jar test runs (seven storm waters x six chemicals x three mixing conditions) are presented graphically in Appendix E, Figures E-1 through E-114.

Typical with chemical addition is that increasing the coagulant dose improves turbidity (settled) until a plateau is reached where additional coagulant will not improve turbidity for a wide range of doses. Beyond some point of additional doses, the settled turbidity will actually decrease. Poor treatment beyond some dose level is a common phenomenon in coagulant dosing and can be attributed to charge reversal. A typical jar test graph of settled turbidity versus dose is shown in Figure 5-11.

For usefulness, the term "effective range" was used to define a range of chemical doses in the jar test runs where the settled turbidity (after 15 minutes) achieved the 20 NTU benchmark. As an example, in Figure 5-11, the "effective range" of the coagulant is approximately 55 mg/L to approximately 145 mg/L (dose expressed as liquid product). There are instances in which the settled turbidity never reached the 20 NTU benchmark (e.g. Figure E-23, Appendix E). In this case, there was no "effective range".

In many cases there was a range of doses that provided settled turbidities near some minimum value or "flat spot" on dose response curve, even though the 20 NTU benchmark was not attained. The "treatment range" is the range of chemical doses where a leveling off of lowest turbidity values occurred, regardless of whether the 20 NTU benchmark was attained. In Figure 5-11, the treatment range is approximately 25 to 160 mg/L (15 minute settled turbidity, blue line). The treatment range is a subjective assessment determined graphically from each of the graphs in Appendix E.

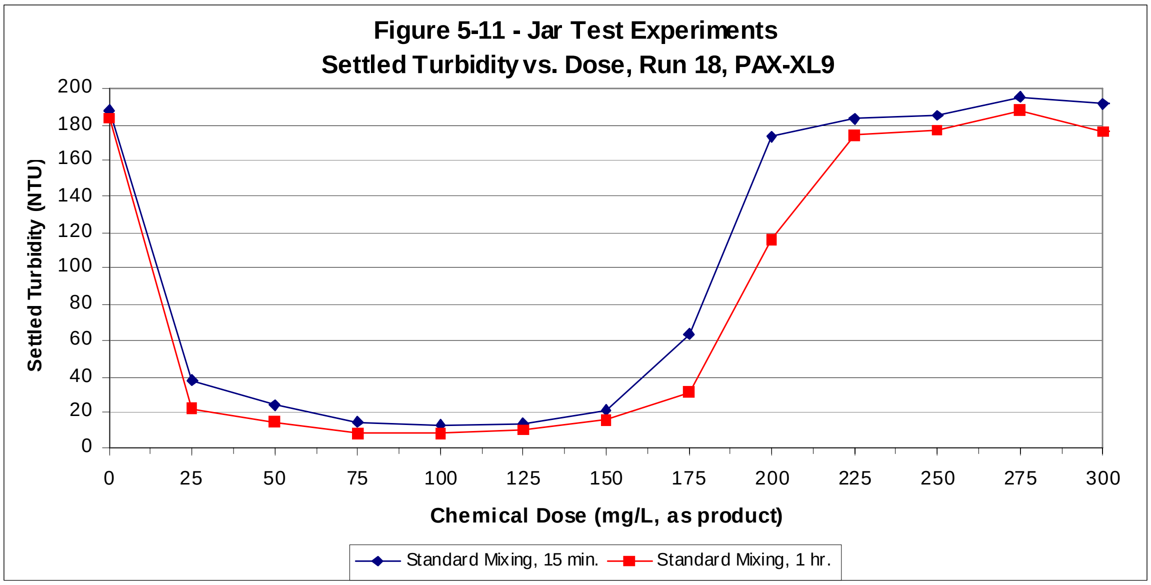


Figure 5-11. Typical Jar Test Graph (Run 18, Coagulant PAX-XL9)

The coagulant dose that achieved the lowest turbidity (after 15 minutes of settling) was termed the "Best Turbidity Dose" (BTD). In Figure 5-11, the BTD for the coagulant PAX-XL9 on Run 18 water was 100 mg/L. Even waters in which the final settled turbidity was above 20 NTU had a BTD but no "effective range". The jar having the BTD was set aside and allowed to settle an additional 45 minutes and sampled for total and dissolved phosphorus.

The BTD, effective range and the treatment range for the six chemicals and seven experimental runs are summarized in Table 5-41. For the PAC products, the BTD ranged from 20 to 290 mg/L. For the PAM products, the BTD ranged from 0.1 to 10 mg/L. It is clear that PASS-C, PAX-XL9 and JC1720 were the most effective chemicals for turbidity reduction. Only the JC1720 was able to attain the 20 NTU treatment benchmark after only 15 minutes of settling in every run. PASS-C and PAX-XL9 were always able to reduce the turbidity to less than 20 NTU after one hour of settling and generally to less than 20 after 15 minutes, with a few exceptions. SumalChlor 50 was the least effective PAC product tested. After 15 minutes of settling, the SumalChlor 50 attained the turbidity benchmark in only two of seven runs (five of seven after 1 hour of settling). Superfloc A-100 was the more effective of the PAM products, able to reduce the turbidity to <20 NTU in five of seven runs within 15 minutes. The SoilFix IR product was never able to attain treatment below 20 NTU.

Table 5-41. Storm Water Used, Effective Dose and Treatment Range for the Chemicals Tested in the Phase IV Jar Tests

Storm Water Used			PAX-XL9®						PASS-C®						SumalChlor 50					
Run	Water Type	Init Turb (NTU)	Best Turb Dose		Effective Dose (Turb <20NTU)		Treatment Range		Best Turb Dose		Effective Dose (Turb <20NTU)		Treatment Range		Best Turb Dose		Effective Dose (Turb <20NTU)		Treatment Range	
			mg/L	NTU	Low mg/L	High mg/L	Low mg/L	High mg/L	mg/L	NTU	Low mg/L	High mg/L	Low mg/L	High mg/L	mg/L	NTU	Low mg/L	High mg/L	Low mg/L	High mg/L
17A	Rain	158	70	17.4	50	105	25	125	50	22.3	None	None	25	155	25	71.9	None	None	15	35
18	Rain	188	100	13.3	55	145	25	160	100	11.7	70	130	50	135	35	47.1	None	None	25	60
19	Rain	805	100	35.8	None	None	25	150	100	25.8	None	None	25	150	20	60.6	None	None	20	45
20	Melt	1698	290	5.0	45	350	75	350	110	14.1	100	160	50	400	45	15.8	45	45	30	60
21	Rain	250	90	12.0	60	200	50	200	100	16.2	45	130	25	140	25	18.4	25	25	10	55
22	Melt	383	125	8.9	40	180	25	200	100	7.9	45	255	25	275	30	29.0	None	None	10	80
23	Mix	251	250	6.4	145	535	100	550	400	4.3	45	555	50	550	130	7.6	100	205	75	225

Storm Water Used			Jenchem 1720						Superfloc A-100						Ciba SoilFix IR					
Run	Water Type	Init Turb (NTU)	Best Turb. Dose		Effective Dose (Turb <20NTU)		Treatment Range		Best Turb. Dose		Effective Dose (Turb <20NTU)		Treatment Range		Best Turb. Dose		Effective Dose (Turb <20NTU)		Treatment Range	
			mg/L	NTU	Low mg/L	High mg/L	Low mg/L	High mg/L	mg/L	NTU	Low mg/L	High mg/L	Low mg/L	High mg/L	mg/L	NTU	Low mg/L	High mg/L	Low mg/L	High mg/L
17A	Rain	158	120	12.5	25	165	20	175	1.20	18.6	1.00	1.20	0.50	2.5	0.80	34.7	None	None	0.25	1.40
18	Rain	188	80	15.3	65	115	50	150	0.50	41.4	None	None	2.5	7.5	0.20	65.5	None	None	0.1	0.3
19	Rain	805	30	13.0	15	90	10	140	2.75	19.6	2.55	2.8	0.75	3.5	1.60	55.1	None	None	0.4	2.50
20	Melt	1698	240	8.3	25	350	25	300	10.0	12.0	8.75	12.0	8.0	15.0	7.00	38.2	None	None	5	10
21	Rain	250	100	13.2	60	100	50	125	0.35	42.8	None	None	0.1	0.6	0.10	78.5	None	None	0.1	0.3
22	Melt	383	175	6.0	25	250	25	275	4.00	9.1	2.9	4.2	0.75	7.0	2.50	43.3	None	None	0.5	5.0
23	Mix	251	200	3.4	75	500	75	525	1.00	22.6	None	None	0.25	2.0	0.50	43.6	None	None	0.1	1.25

Effective Doses and Dose Ranges

By examining the data in Table 5-41 some conclusions about the Phase IV performance of the individual chemicals can be made. Summarized in Table 5-42 are the average (n = 7) BTD, the average turbidity attained at the BTD (15 minutes of settling), and the average span of the "effective" and "treatment ranges". Larger spans of the effective and treatment ranges mean that there would be more resiliency in the treatment system to provide treatment even with variations from a target dose.

As indicated in Table 5-42, Jenchem 1720 had the lowest average turbidity after 15 minutes of settling at the BTD and, together with PAX-XL9 and PASS-C, had wide treatment ranges.

Table 5-42. Average of the BTD Turbidly Dose, Average 15 Minute Settled Turbidity (at the BTD) and the Span of the Effective and Treatment Ranges

Chemical	Average Phase IV BTD (mg/L)	Average of the Settled Turbidity Values (15 min. @ BTD, in NTU)	Average Span of the Ranges (mg/L)	
			Effective Range	Treatment Range
Jenchem 1720	135	10.2	183	205
PAX-XL9	146	14.1	187	201
PASS-C	137	14.6	185	222
Superfloc A-100	2.8	23.7	1.3	3.6
SumalChlor 50	44.3	35.8	35	54
SoilFix IR	1.8	51.3	None	2.0

The BTD and ranges of effective doses versus storm water turbidity for the six chemicals are shown graphically in Figures 5-12 through 5-17. In the figures, a hollow data marker indicates that, at the BTD, the coagulant attained treatment at or below the 20 NTU benchmark. Solid data markers indicate that the chemical at the indicated dose resulted in a settled turbidity above 20 NTU. Range bars are shown on the successful jars indicating the upper and lower bounds of the effective range.

From Figure 5-12, a dose of PAX-XL9 of approximately 100 mg/L provided treatment to below 20 NTU for almost all storm waters tested (under the conditions used). Similarly, a dose between 100-110 mg/L of PASS-C provided treatment below 20 NTU in six of the seven storm waters (Figure 5-13). From Figure 5-15, a range between 25 to 115 mg/L of JC1720 provided treatment to below 20 NTU in all seven runs. Superfloc A-100 performed quite well, although not as well at the PACs. SumalChlor 50 and SoilFix IR were relatively ineffective in turbidity removals, and no common doses were able to provide effective treatment for the variation of storm waters tested (Figures 5-14, 5-16 and 5-17).

Both PAX-XL9 and PASS-C were included in the Phase III jar test runs. The ranges of effective doses (i.e. < 20 NTU) for PAX-XL9 and PASS-C for both phases are shown graphically in Figures 5-18 and 5-19, respectively. There were 10 different storm waters tested in Phase III and seven in Phase IV. From Figure 5-18 a dose of 100 mg/L of PAX-XL9 reduced the turbidity of 13 of 17 (76%) storm waters to below 20 NTU (after 15 minutes of settling in the jars). A dose of 100 mg/L of PASS-C treated 12 of 17 waters to below the turbidity benchmark (Figure 5-19).

Based on both Phases III and IV, a dose of 100 mg/L appears to be the best general dose for the two chemicals.

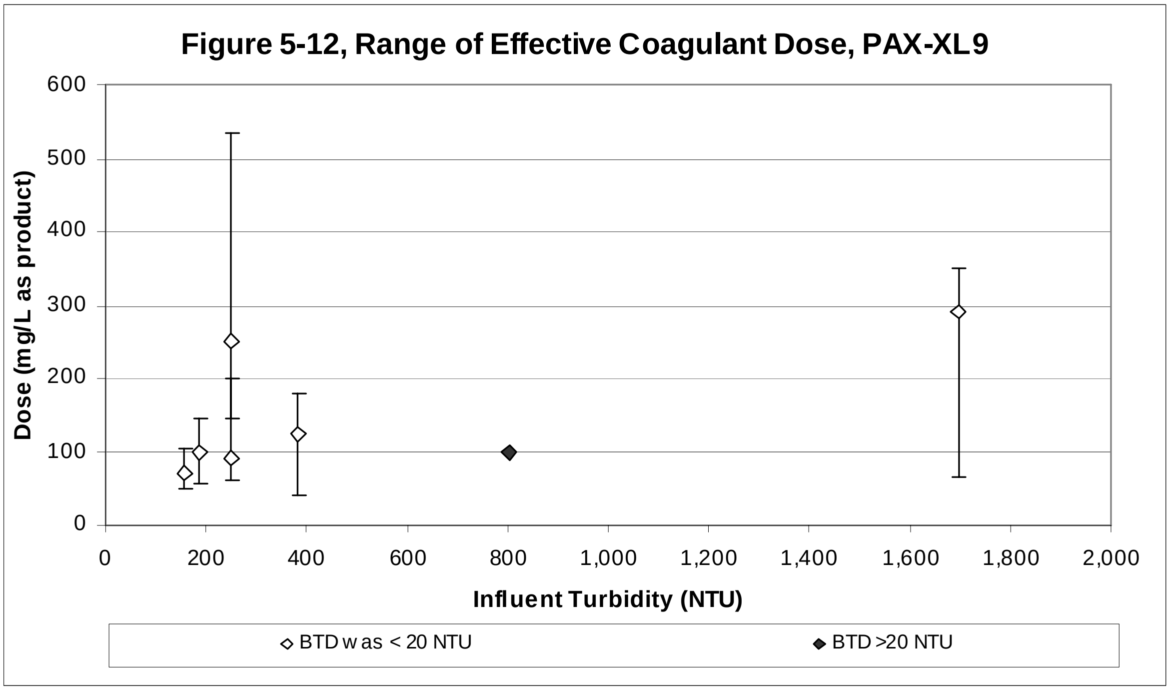


Figure 5-12. Range of Effective Doses – PAX-XL9

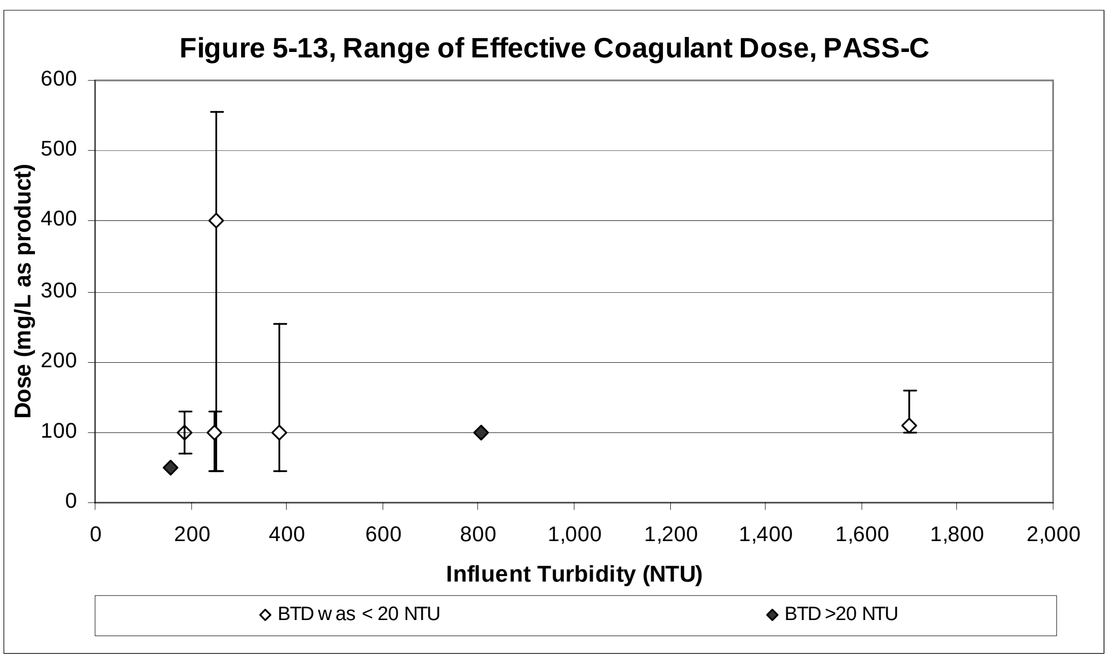


Figure 5-13. Range of Effective Doses – PASS-C

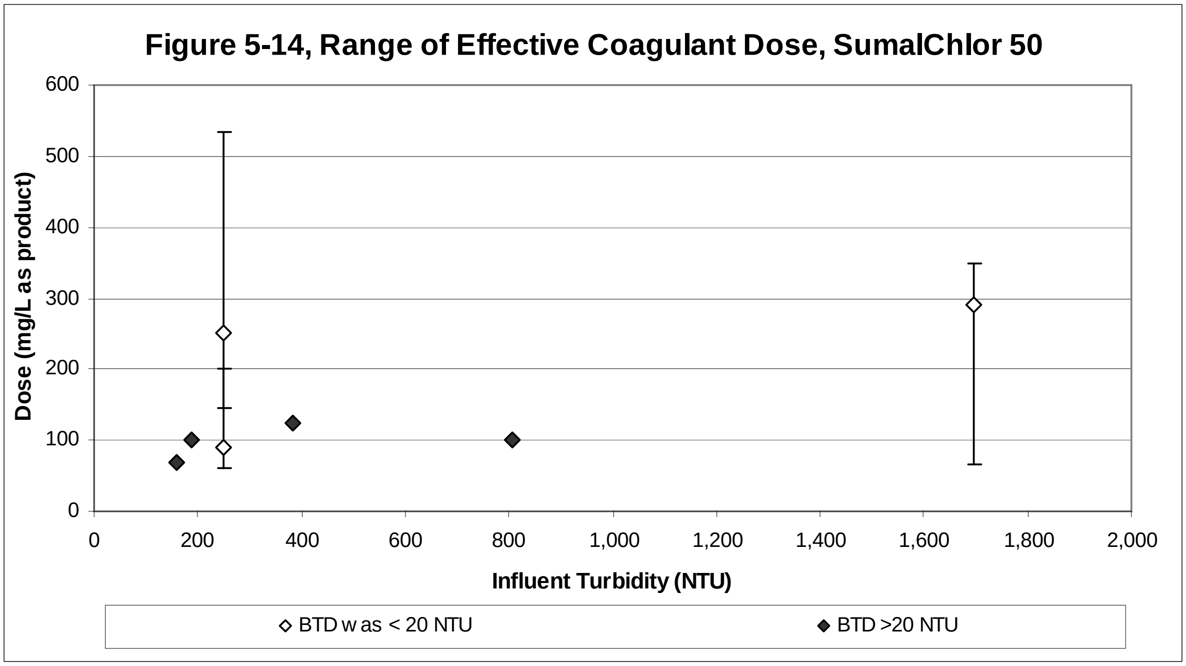


Figure 5-14. Range of Effective Doses – SumalChlor 50

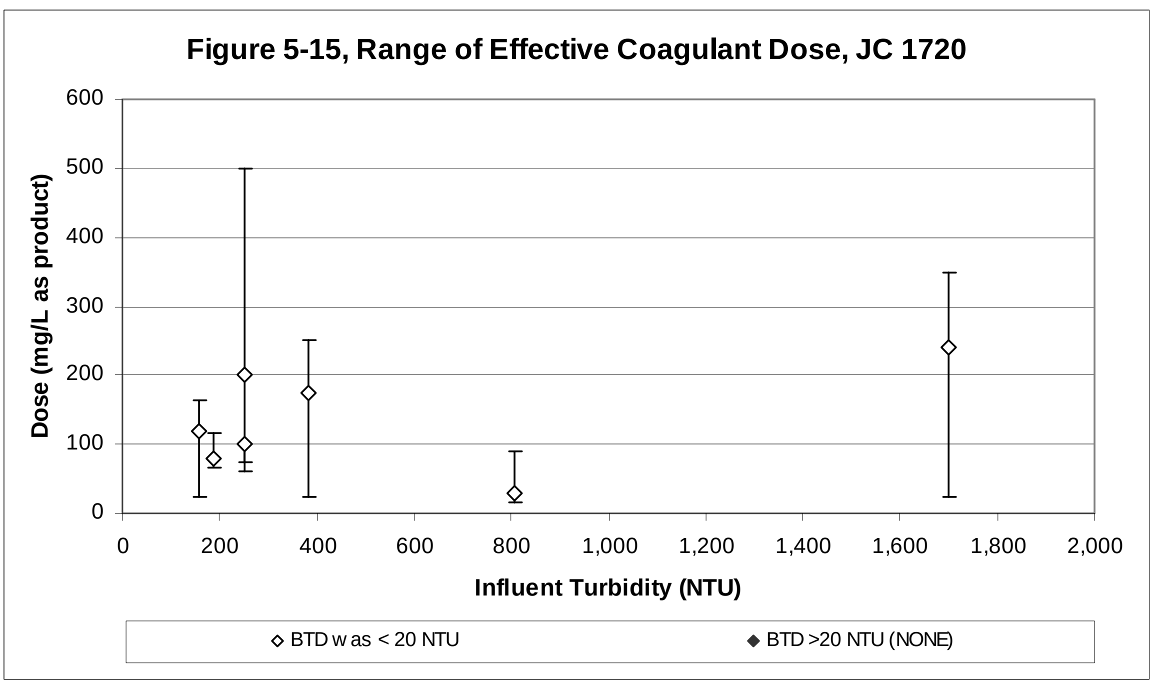


Figure 5-15. Range of Effective Doses – Jenchem 1720

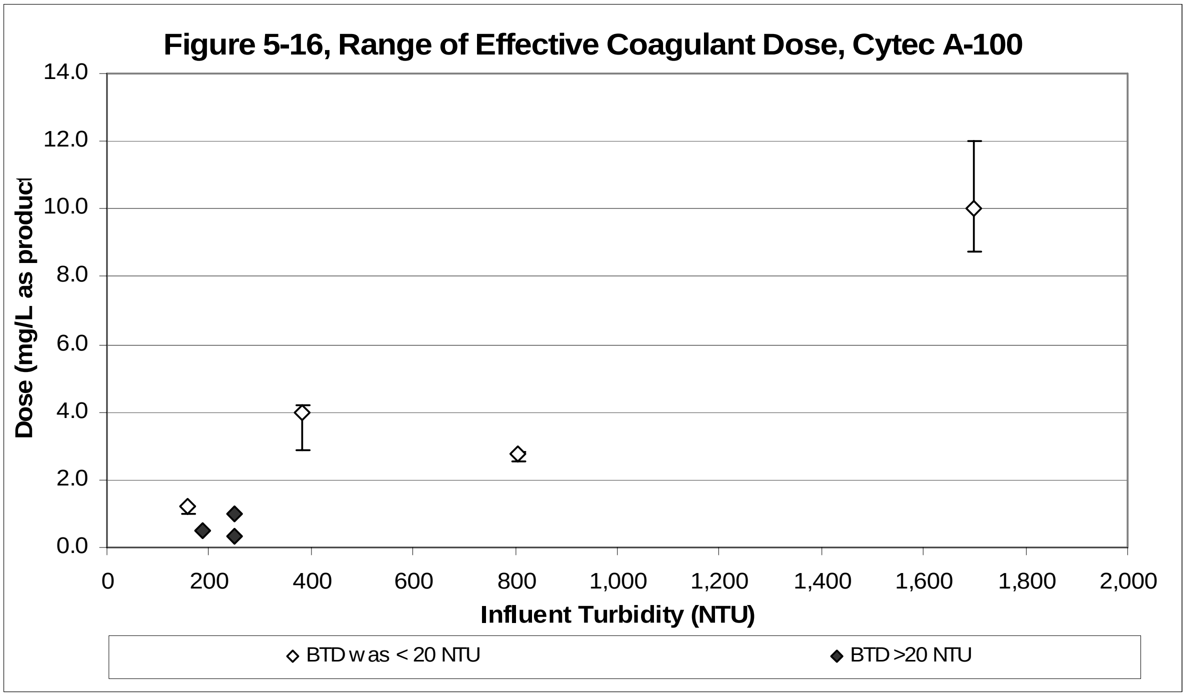


Figure 5-16. Range of Effective Doses – Cytec Superfloc A-100

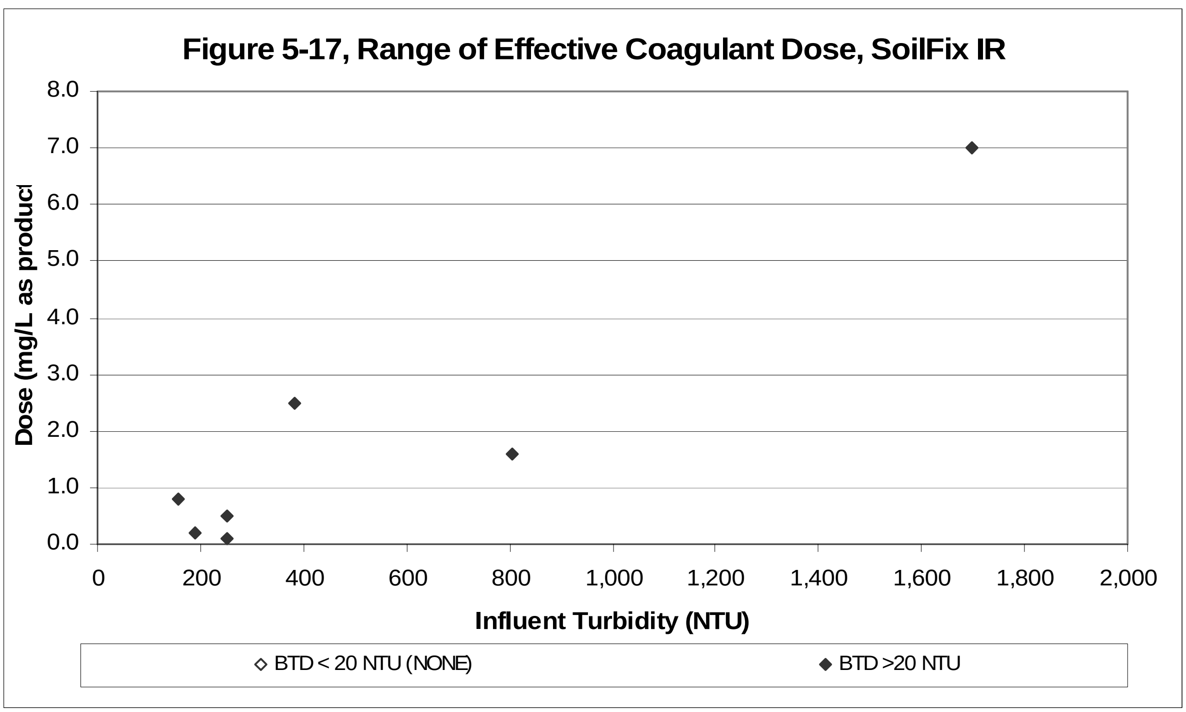


Figure 5-17. Range of Effective Doses – SoilFix IR

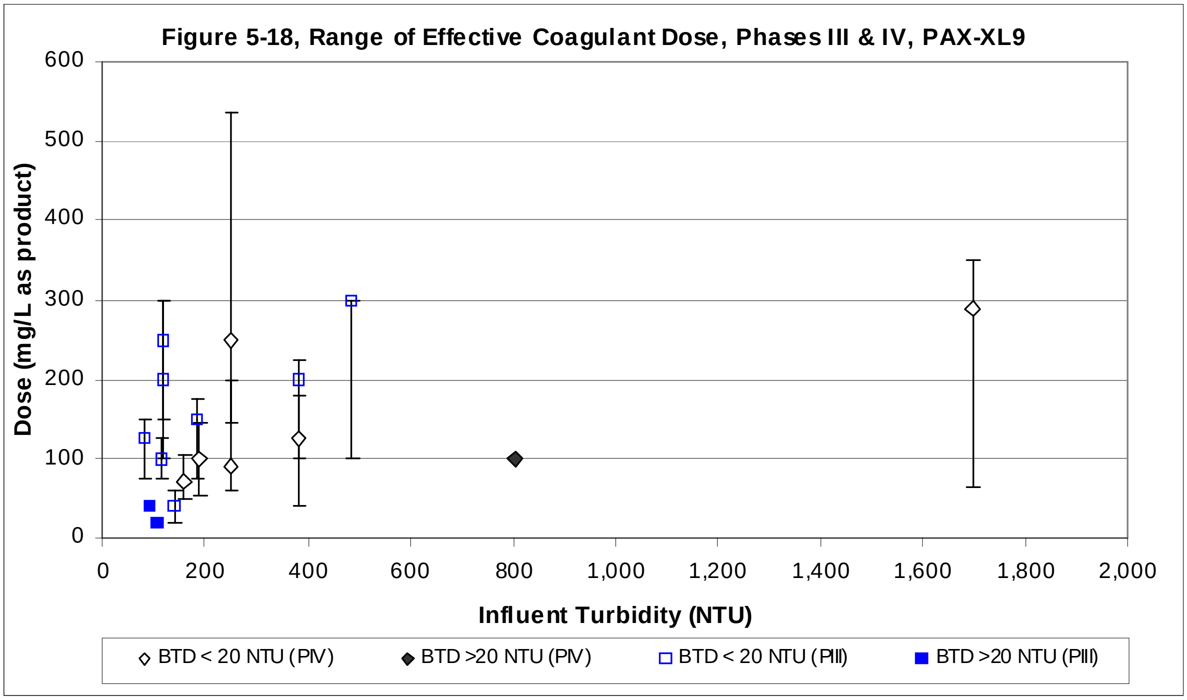


Figure 5-18. Range of Effective Doses – PAX-XL9, Phases III and IV

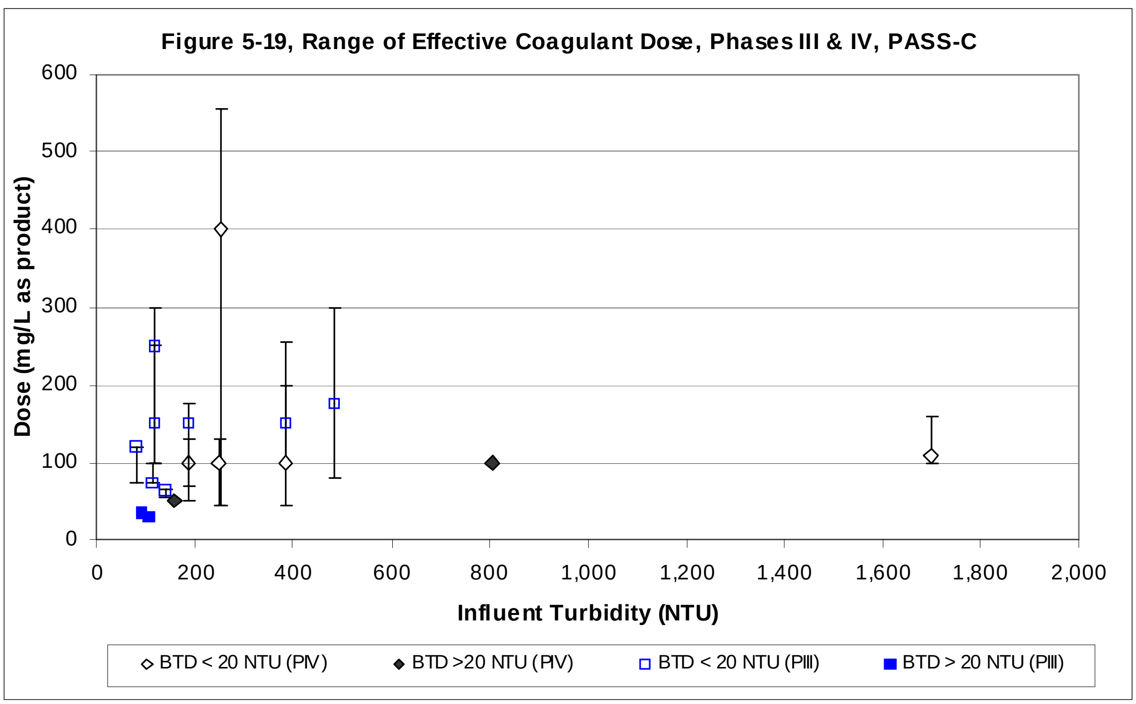


Figure 5-19. Range of Effective Doses – PASS-C, Phases III and IV

Change in Turbidity with Additional Settling Time

The best turbidity dose was selected after only 15 minutes of settling; however, all jars in Phase IV were allowed to settle an additional 45 minutes and turbidity was re-checked. As can be seen from the various figures in Appendix E, the 1 hour settled turbidity (red line) at times was appreciably lower than the 15 minute value (blue line). The one-hour BTD settled turbidity values are presented and compared to the 15-minute turbidity values in Table 5-43.

Table 5-43. Settled Turbidities at 15 Minutes and One Hour at BTD

	PAX-XL9			PASS-C			SumalChlor 50		
	Best Settled Turbidity, NTU			Best Settled Turbidity, NTU			Best Settled Turbidity, NTU		
Run	15 Min.	1 Hour	% Change	15 Min.	1 Hour	% Change	15 Min.	1 Hour	% Change
17A	17.4	10.9	-37.4	22.3	8.9	-60.1	71.9	32.2	-55.2
18	13.3	8.3	-38.0	11.7	8.2	-29.9	47.1	19.8	-58.0
19	35.8	10.3	-71.2	25.2	14.1	-44.1	60.6	29.4	-51.5
20	5.0	2.1	-58.0	14.1	5.1	-63.8	15.8	5.2	-67.1
21	12.0	5.9	-50.8	16.2	7.1	-56.2	18.4	11.0	-40.2
22	8.9	6.4	-28.1	7.9	4.3	-45.6	29.0	12.1	-58.3
23	6.4	2.5	-61.1	4.3	2.0	-53.3	7.6	4.7	-38.2
Mean =	14.1	6.6	-49.2	14.5	7.1	-50.4	35.8	16.3	-52.6
	JC1720			Superfloc A-100			SoilFix IR		
	Best Settled Turbidity, NTU			Best Settled Turbidity, NTU			Best Settled Turbidity, NTU		
Run	15 Min.	1 Hour	% Change	15 Min.	1 Hour	% Change	15 Min.	1 Hour	% Change
17A	12.5	10.2	-18.4	18.6	15.0	-19.4	34.7	28.3	-18.4
18	15.3	8.7	-43.1	41.4	33.2	-19.8	65.5	55.2	-15.7
19	13.0	7.7	-40.8	19.6	17.1	-12.8	55.1	48.1	-12.7
20	8.3	3.3	-60.2	12.0	11.2	-6.7	38.2	21.2	-44.5
21	13.2	7.4	-43.9	42.8	35.3	-17.5	78.5	67.6	-13.9
22	6.0	3.9	-35.0	9.1	8.7	-4.4	43.3	33.6	-22.4
23	3.4	2.46	-27.2	22.6	20.5	-9.3	43.6	42.9	-1.6
Mean	10.2	6.2	-38.4	23.7	20.1	-12.8	51.3	42.4	-18.5

As expected, additional settling time increased turbidity removals. Turbidities after one hour of settling for the PAX-XL9, PASS-C, SumalChlor 50 dosed jars were typically 50 percent lower than the 15 minute values. Turbidities of the JC1720, which were quite good after only 15 minutes, improved an average of 38 percent after an additional 45 minutes of settling. Both of the PAM products had the least improvement in turbidity removal with additional settling time.

5.3.2 Sensitivity to Mixing

In each experimental run, a second set of jar tests were conducted using the shortened mixing conditions outlined in Table 3-8. Typically, six doses spanning a wide range were selected. Therefore, full mixing sensitivity performance curves for the various chemicals were not developed to the same extent as they were for standard mixing. Graphs for the mixing sensitivity jars are included in Appendix E. Like in the standard mixing jars, turbidity was measured after 15 minutes and 1 hour of settling.

For relative comparison purposes, the BTD or a dose very close to the BTD was selected and the difference between turbidity readings for the standard mixing and mixing sensitivity jar tests was computed. These comparisons are summarized in Table 5-44 and Table 5-45 for 15 minutes and one hour of settling, respectively.

On the average, the final settled turbidity after 15 minutes of the BTD was approximately 50 NTU higher in the mixing sensitivity jars than in the standard mixing jars for PAX-XL9, PASS-C and JC1720 (Table 5-44). After 1 hour of settling, the difference between the two mixing scenarios decreased to about 25 NTU for the same chemicals (Table 5-45). As can be seen in Figures E-25 and E-26, at times the treatment range was narrower in the mixing sensitivity jars than observed under standard mixing conditions.

SumalChlor 50, which in general had a narrow range of effective doses, had an average difference of 84 NTU between the standard mixing and mixing sensitivity jars after 15 minutes. The difference in mixing also decreased for the SumalChlor 50 jars after one hour (average difference decreased to 25 NTU, Table 5-45). Not only is the settled turbidity affected by mixing but so is the treatment curve. As can be seen in Figures E-9, E-27, E-45, E-75 and E-111, the mixing sensitivity treatment curve was shifted to the left, indicating that smaller doses of SumalChlor 50 were required when the mixing conditions were shortened.

Superfloc A-100 had an average difference of 32 NTU between the standard mixing and mixing sensitivity jars after 15 minutes, but the difference decreased to near zero after one hour of settling. The difference in turbidity removal performance for the SoilFix IR jars was also less after one hour than after 15 minutes of settling (21 vs. 40 NTU).

5.3.3 Temperature Sensitivity

Another set of jar tests was performed following the standard mixing jar test experiments (storm water at ambient temperature) using the same water cooled in an ice bath. Mixing conditions used for the temperature sensitivity runs were the same as those used in the standard mixing runs (see Table 3-8). Because the ambient temperature of the storm water used in the standard mixing runs was below 5ºC in three of the experimental runs, no temperature sensitivity jar tests were completed for these runs. Typically, 6 jars of cold water with chemical doses spanning a wide range were used in the temperature sensitivity tests. As was the case for the mixing sensitivity tests, the temperature sensitivity tests were not conducted over the full dose range used for standard mixing. Graphs of the temperature sensitivity jar test results are included in Appendix E. Like the other jar tests, turbidity was measured after 15 minutes and one hour of settling.

Table 5-44. Settled Turbidities at 15 Minutes for the Standard Mixing and Mixing Sensitivity Jars

Run	PAX-XL9				PASS-C				SumalChlor 50			
	Dose (mg/L)	Std. Mix Turb. (NTU)	Mix. Sen. Turb. (NTU)	Diff. (NTU)	Dose (mg/L)	Std. Mix Turb. (NTU)	Mix. Sen. Turb. (NTU)	Diff. (NTU)	Dose (mg/L)	Std. Mix Turb. (NTU)	Mix. Sen. Turb. (NTU)	Diff. (NTU)
17A	75	17.5	78.4	60.9	50	22.3	108	85.7	20	74.5	161	86.5
18	125	13.8	110	96.2	100	11.7	65.6	53.9	35	47.1	178	131
19	100	35.8	56.5	20.7	100	25.2	90.1	64.9	20	60.6	156	95.4
20	150	10.4	29.7	19.3	100	19.0	45.2	26.2	50	43.8	33.8	-10.0
21	90	12.0	79.7	67.7	100	16.2	135	119	20	28.6	84.2	55.6
22	100	10.6	73.3	62.7	75	13.9	28.0	14.1	30	29.0	89.8	60.8
23	200	5.1	17.0	11.9	400	4.3	9.7	5.4	100	16.1	188	172
Avg=	120	15.0	63.5	48.5	132	16.1	68.8	52.7	39.3	42.8	127	84.4

Run	JC1720				Superfloc A-100				SoilFix IR			
	Dose (mg/L)	Std. Mix Turb. (NTU)	Mix. Sen. Turb. (NTU)	Diff. (NTU)	Dose (mg/L)	Std. Mix Turb. (NTU)	Mix. Sen. Turb. (NTU)	Diff. (NTU)	Dose (mg/L)	Std. Mix Turb. (NTU)	Mix. Sen. Turb. (NTU)	Diff. (NTU)
17A	100	13.0	40.5	27.5	1.25	21.2	46.3	25.1	1.0	42.1	88.7	46.6
18	80	15.3	90.2	74.9	0.5	41.4	60.7	19.3	0.2	65.5	112	46.5
19	30	13.0	80.0	67.0	2.75	19.6	24.5	4.9	1.0	77.4	81.2	3.8
20	200	9.6	18.5	8.9	10.0	12.0	73.2	61.2	8.0	4.3	68.1	63.8
21	100	13.2	167	154	0.35	42.9	112	69.2	0.1	78.5	126	47.5
22	150	7.2	49.7	42.5	4.0	9.1	44.5	35.4	1.5	46.1	66.0	19.9
23	200	3.4	17.6	14.2	1.0	22.6	34.4	11.8	0.5	43.6	95.0	51.4
Avg=	123	10.7	66.2	55.5	2.8	24.1	56.5	32.4	1.8	51.1	91.0	39.9

Table 5-45. Settled Turbidities at 1 hour for the Standard Mixing and Mixing Sensitivity Jars

	PAX-XL9				PASS-C				SumalChlor 50			
Run	**Dose (mg/L)**	**Std. Mix Turb. (NTU)**	**Mix. Sen. Turb. (NTU)**	**Diff. (NTU)**	**Dose (mg/L)**	**Std. Mix Turb. (NTU)**	**Mix. Sen. Turb. \(NTU)**	**Diff. (NTU)**	**Dose (mg/L)**	**Std. Mix Turb. (NTU)**	**Mix. Sen. Turb. (NTU)**	**Diff. (NTU)**
17A	75	10.9	41.5	30.6	50.0	8.9	43.7	34.8	20	33.6	140	106.4
18	125	10.4	50.3	39.9	100	8.2	35.2	27.0	35	19.8	74.8	55.0
19	100	10.3	26.1	15.8	100	14.1	39.1	25.0	20	29.4	72.6	43.2
20	150	3.2	12.2	9.0	100	10.5	19.1	8.6	50	9.7	14.8	5.1
21	90	5.9	25.5	19.6	100	7.1	21.7	14.6	20	13.3	37.1	23.8
22	100	6.2	32.3	26.1	75.0	5.9	20.4	14.5	30	12.1	46.5	34.4
23	200	3.8	7.5	3.8	400	2.0	5.2	3.2	100	6.2	17.9	11.7
Avg=	120	7.2	27.9	20.7	132	8.1	26.3	18.2	39	17.7	57.7	39.9
	JC1720				**Superfloc A-100**				**SoilFix IR**			
Run	**Dose (mg/L)**	**Std. Mix Turb. (NTU)**	**Mix. Sen. Turb. (NTU)**	**Diff. (NTU)**	**Dose (mg/L)**	**Std. Mix Turb. (NTU)**	**Mix. Sen. Turb. (NTU)**	**Diff. (NTU)**	**Dose (mg/L)**	**Std. Mix Turb. (NTU)**	**Mix. Sen. Turb. (NTU)**	**Diff. (NTU)**
17A	100	10.5	17.5	7.0	1.25	16.6	24.7	8.1	1.0	33.6	45.9	12.3
18	80	8.7	35.4	26.7	0.50	33.2	42.0	8.8	0.2	55.2	97.2	42.0
19	30	7.7	22.9	15.2	2.75	17.1	24.1	7.0	1.0	72.5	77.6	5.1
20	200	4.2	11.7	7.5	10.0	11.2	71.6	60.4	8.0	31.4	46.2	14.8
21	100	7.4	56.6	49.2	0.35	35.3	89.2	53.9	0.1	67.6	104	36.4
22	150	4.8	26.3	21.5	4.0	8.7	19.9	11.2	1.5	44.7	50.4	5.7
23	200	2.46	5.7	3.2	1.0	205	26.6	-178	0.5	42.9	75.9	33.0
Avg=	123	6.5	25.2	18.6	2.8	46.7	42.6	-4.1	1.8	49.7	71.0	21.3

For comparison purposes the BTD (or a dose very close to the BTD) was selected and the difference between turbidity readings for the standard mixing and temperature sensitivity jar tests was computed for each chemical in each run. These comparisons are summarized in Tables 5-46 and 5-47 for 15 minutes and one hour of settling, respectively.

For most chemicals tested, there was very little difference in settled turbidity with water temperature. For PASS-C, PAX-XL9 and JC1720 the average difference in turbidities between the standard mixing runs at ambient temperature and the cold jars after 15 minutes of settling was less than 10 NTU. The difference was even smaller after one hour of settling (Table 5-47).

The SumalChlor 50 jars had an average turbidity difference of 78 NTUs higher in the cold jars after 15 minutes of settling. This gap decreased to 25 NTU after one hour. It should be emphasized that these high differences are based on turbidities of both tests at the BTD of the standard mixing test. This is appropriate if the intent is to show how performance at a dose established for one temperature is impacted by operation at another temperature. However, this analysis does not compare the best possible performances with differing doses at the two temperatures. For example, by review of the Run 23 graph in Figure E-111, it can be seen that the BTD for SumalChlor 50 at the lower temperature was around 50 mg/L and that turbidity performance at this dose was similar to that of the standard mixing test at the 100 mg/L dose.

There was little difference in the performance of the PAM products due to water temperature. If anything, the performance may be slightly better at colder water temperatures.

5.3.4 Jar Test Phosphorus Removal

After one hour of settling, the BTD jars from the standard mixing tests were sampled and analyzed for total and dissolved phosphorus. Complete phosphorus data collected for the jar test runs are presented in Appendix D. Turbidity and total phosphorus data for the BTD jars are summarized in Table 5-48. In Table 5-49, turbidity and dissolved phosphorus data are provided.

As shown in Table 5-48, the removal of total phosphorus in the PAC dosed jars after one hour of settling averaged between 93.8 and 97.4 percent (Table 5-48). The JC1720 had the highest percent removal of Phos-T, removing an average (n = 7) of 97.4 percent. Average Phos-T percent removal at the BTD was 97.0 percent for the PAX-XL9, 93.9 percent for the PASS-C and 93.8 percent for the SumalChlor 50. The data for removal of dissolved phosphorus (Table 5-49) are more limited, but on average (n = 3) the PAC chemicals removed 100 percent of the Phos-D. In general, the PAM products were less successful in removing total and dissolved phosphorus.

In addition to the BTD jar, in each run a second jar was selected for phosphorus sampling after one hour of settling. The second jar was typically the 100 mg/L dosed jar except when the BTD was 100 mg/L. In that case, another jar was selected. Turbidity and total phosphorus results of these “alternate” jar doses are presented in Table 5-50.

Table 5-46. Settled Turbidities at 15 Minutes for the Standard Mixing and Temperature Sensitivity Jars

Run	PAX-XL9				PASS-C				SumalChlor 50			
	Dose (mg/L)	Std. Mix Turb. (NTU)	Temp. Sen. Turb. (NTU)	Diff. (NTU)	Dose (mg/L)	Std. Mix Turb. (NTU)	Temp. Sen. Turb. (NTU)	Diff. (NTU)	Dose (mg/L)	Std. Mix Turb. (NTU)	Temp. Sen. Turb. (NTU)	Diff. (NTU)
17A	75	17.5	22.9	5.4	50	22.3	24.0	1.7	20	74.5	118	43.5
19	100	35.8	27.6	-8.2	100	25.2	67.1	41.9	20	60.6	79.0	18.4
22	100	10.6	13.9	3.3	75	13.9	15.0	1.1	30	29.0	29.7	0.7
23	200	5.1	5.1	0.0	400	4.3	8.4	4.1	100	16.1	267	251
Avg=	120	15.0	17.4	0.1	132	16.1	28.6	12.2	39	42.8	123	78.4
	JC1720				Superfloc A-100				SoilFix IR			
Run	Dose (mg/L)	Std. Mix Turb. (NTU)	Temp. Sen. Turb. (NTU)	Diff. (NTU)	Dose (mg/L)	Std. Mix Turb. (NTU)	Temp. Sen. Turb. (NTU)	Diff. (NTU)	Dose (mg/L)	Std. Mix Turb. (NTU)	Temp. Sen. Turb. (NTU)	Diff. (NTU)
17A	100	13.0	19.1	6.1	1.25	21.2	23.0	1.8	1.0	42.1	38.0	-4.1
19	30	13.0	21.4	8.4	2.75	19.6	18.3	-1.3	1.0	77.4	79.9	2.5
22	150	7.2	8.7	1.5	4.0	9.1	19.4	10.3	1.5	46.1	41.6	-4.5
23	200	3.4	30.1	26.7	1.0	22.6	27.0	4.4	0.50	43.6	51.7	8.1
Avg=	123	10.7	19.8	10.7	2.8	24.1	21.9	3.8	1.8	51.1	52.8	0.50

Table 5-47. Settled Turbidities at 1 Hour for the Standard Mixing and Temperature Sensitivity Jars

Run	PAX-XL9				PASS-C				SumalChlor 50			
	Dose (mg/L)	Std. Mix Turb. (NTU)	Temp. Sen. Turb. (NTU)	Diff. (NTU)	Dose (mg/L)	Std. Mix Turb. (NTU)	Temp. Sen. Turb. (NTU)	Diff. (NTU)	Dose (mg/L)	Std. Mix Turb. (NTU)	Temp. Sen. Turb. (NTU)	Diff. (NTU)
17A	75	10.9	19.3	8.4	50	8.9	12.5	3.6	20	33.6	49.3	15.7
19	100	10.3	20.4	10.1	100	14.1	24.1	10.0	20	29.4	23.0	-6.4
22	100	6.2	10.6	4.4	75	5.9	12.6	6.7	30	12.1	15.1	3.0
23	200	3.8	2.1	-1.7	400	2.0	4.6	2.6	100	6.2	94.9	88.7
Avg=	120	7.2	13.1	5.3	132	8.1	13.5	5.7	39	17.7	45.6	25.3
	JC1720				Superfloc A-100				SoilFix IR			
Run	Dose (mg/L)	Std. Mix Turb. (NTU)	Temp. Sen. Turb. (NTU)	Diff. (NTU)	Dose (mg/L)	Std. Mix Turb. (NTU)	Temp. Sen. Turb. (NTU)	Diff. (NTU)	Dose (mg/L)	Std. Mix Turb. (NTU)	Temp. Sen. Turb. (NTU)	Diff. (NTU)
17A	100	10.5	12.9	2.4	1.25	16.6	15.4	-1.2	1.0	33.6	25.7	-7.9
19	30	7.7	11.8	4.1	2.75	17.1	17.2	0.1	1.0	72.5	71.4	-1.1
22	150	4.8	6.7	1.9	4.0	8.7	13.4	4.7	1.5	44.7	38.2	-6.5
23	200	2.5	1.5	-1.0	1.0	205	22.5	-183	0.5	42.9	45.5	2.6
Avg=	123	6.5	8.2	1.9	2.8	46.7	17.1	-44.7	1.8	49.7	45.2	-3.2

Table 5-48. Turbidity and Total Phosphorus Measured in the BTD Jars after One Hour of Settling

Run	Influent Phos-T (mg/L)	PAX-XL9				PASS-C				SumalChlor 50			
		Dose (mg/L)	Final Turbidity (NTU)	Phos-T (mg/L)	Percent Phos-T Removal	Dose (mg/L)	Final Turbidity (NTU)	Phos-T (mg/L)	Percent Phos-T Removal	Dose (mg/L)	Final Turbidity (NTU)	Phos-T (mg/L)	Percent Phos-T Removal
17A	0.12	70	10.9	< 0.03	100	50	8.9	< 0.03	100	25	32.2	0.03	75.0
18	0.34	100	8.3	< 0.03	100	100	8.2	< 0.03	100	35	19.8	< 0.03	100
19	0.35	100	10.3	< 0.03	100	100	14.1	< 0.03	100	20	29.4	< 0.03	100
20	1.37	290	2.1	< 0.03	100	110	5.1	< 0.03	100	45	5.2	< 0.03	100
21	0.57	90	5.9	< 0.03	100	100	7.1	< 0.03	100	25	11.0	< 0.03	100
22	0.62	125	6.4	< 0.03	100	100	4.3	0.15	75.8	30	12.1	< 0.03	100
23	0.76	250	2.5	0.16	78.9	400	2.0	0.14	81.6	130	4.7	0.14	81.6
Average Percent Phos-T Removal					97.0				93.9				93.8

Run	Influent Phos-T (mg/L)	JC1720				Superfloc A-100				Ciba SoilFix IR			
		Dose (mg/L)	Final Turbidity (NTU)	Phos-T (mg/L)	Percent Phos-T Removal	Dose (mg/L)	Final Turbidity (NTU)	Phos-T (mg/L)	Percent Phos-T Removal	Dose (mg/L)	Final Turbidity (NTU)	Phos-T (mg/L)	Percent Phos-T Removal
17A	0.12	120	10.2	< 0.03	100	1.20	15.0	< 0.03	100	0.80	28.3	0.03	75.0
18	0.34	70	8.7	< 0.03	100	0.50	33.2	< 0.03	100	0.20	55.2	< 0.03	100
19	0.35	30	7.7	< 0.03	100	2.75	17.1	< 0.03	100	1.60	48.1	< 0.03	100
20	1.37	240	3.3	< 0.03	100	10.00	11.2	< 0.03	100	7.00	21.2	0.09	93.4
21	0.57	100	7.4	< 0.03	100	0.35	35.3	0.06	89.5	0.10	67.6	0.13	77.2
22	0.62	175	3.9	< 0.03	100	4.00	8.7	0.11	82.3	2.50	33.6	0.13	79.0
23	0.76	200	2.5	0.14	81.6	1.00	20.5	0.35	53.9	0.50	42.9	0.33	56.6
Average Percent Phos-T Removal					97.4				89.4				83.0

Table 5-49. Turbidity and Dissolved Phosphorus Measured in the BTD Jars after One Hour of Settling

Run	Influent Phos-D (mg/L)	PAX-XL9				PASS-C				SumalChlor 50			
		Dose (mg/L)	Final Turbidity (NTU)	Phos-D (mg/L)	Percent Phos-D Removal	Dose (mg/L)	Final Turbidity (NTU)	Phos-D (mg/L)	Percent Phos-D Removal	Dose (mg/L)	Final Turbidity (NTU)	Phos-D (mg/L)	Percent Phos-D Removal
20	0.06	290	2.1	< 0.03	100	110	5.1	< 0.03	100	45	5.2	< 0.03	100
22	0.07	125	6.4	<0.03	100	100	4.3	<0.03	100	30	12.1	<0.03	100
23	0.19	250	2.5	<0.03	100	400	2.0	<0.03	100	130	4.7	<0.03	100
Average Percent Phos-D Removal					100				100				100
Run	Influent Phos-D (mg/L)	JC1720				Superfloc A-100				Ciba SoilFix IR			
		Dose (mg/L)	Final Turbidity (NTU)	Phos-D (mg/L)	Percent Phos-D Removal	Dose (mg/L)	Final Turbidity (NTU)	Phos-D (mg/L)	Percent Phos-D Removal	Dose (mg/L)	Final Turbidity (NTU)	Phos-D (mg/L)	Percent Phos-D Removal
20	0.06	240	3.3	< 0.03	100	10.00	11.2	< 0.03	100	7.00	21.2	0.07	30.0
22	0.07	175	3.9	<0.03	100	4.00	8.7	0.08	11.1	2.50	33.6	0.08	11.1
23	0.19	200	2.5	<0.03	100	1.00	20.5	0.19	0	0.50	42.9	0.20	-5.3
Average Percent Phos-D Removal					100				37.0				11.9

In all cases, the average (n = 7) percent removals for doses different than the BTD (both higher and lower) were not as good as those measured for the BTD. For PASS-C, PAX-XL9 and JC1720 the Phos-T percent removal at 100 mg/L was less than that observed with the BTD four of 13 times. A 100 mg/L dose of SumalChlor 50 removed on average 68.8 percent of the Phos-T while the BTD removed 97.4 percent of the Phos-T. The alternate dose selected for the PAM products was typically an excess dose. The Phos-T removal percentage for Superfloc A-100 was about the same regardless of dose. Increasing the dose of SoilFix IR slightly reduced the average Phos-T removal (Table 5-50).

Table 5-50. Turbidity and Total Phosphorus Removals at the BTD and Alternate Dose after One Hour of Settling in the Jars

Run	Chemical	Chemical Dose			Measured Turbidity (1 hr) (NTU)			Phos-T Removal		
		BTD (mg/L)	Alt. Dose (mg/L)	Difference (mg/L)	BTD	Alt. Dose	Difference	Total-P (mg/L)	BTD %R	Alt. Dose %R
17A	PASS-C	50	100	50	8.9	15.2	6.3	0.12	100	100
18	PASS-C	100	125	25	8.2	9.6	1.4	0.34	100	5.9
19	PASS-C	100	130	30	14.1	15.2	1.1	0.35	100	100
20	PASS-C	110	100	-10	5.1	10.5	5.4	1.37	100	100
21	PASS-C	100	20	-80	7.1	57.4	50.3	0.57	100	78.9
22	PASS-C	100	25	-75	4.3	21.8	17.5	0.62	75.8	74.2
23	PASS-C	400	100	-300	2.0	3.2	1.2	0.76	81.6	80.3
								avg =	**93.9**	**77.0**
17A	PAX-XL9	70	100	30	10.9	14.1	3.2	0.12	100	66.7
18	PAX-XL9	100	50	-50	8.3	14.4	6.2	0.34	100	100
19	PAX-XL9	100	140	40	10.3	35.1	24.8	0.35	100	100
20	PAX-XL9	290	100	-190	2.1	2.9	0.8	1.37	100	100
21	PAX-XL9	90	100	10	5.9	6.6	0.7	0.57	100	100
22	PAX-XL9	125	100	-25	6.4	6.2	-0.2	0.62	100	100
23	PAX-XL9	250	100	-150	2.5	11.5	9.0	0.76	78.9	80.3
								avg =	**97.0**	**92.4**
17A	JC1720	120	100	-20	10.2	10.5	0.3	0.12	100	100
18	JC1720	70	100	30	8.7	9.1	0.4	0.34	100	100
19	JC1720	30	100	70	7.7	12.9	5.2	0.35	100	100
20	JC1720	240	100	-140	3.3	3.6	0.3	1.37	100	100
21	JC1720	100	60	-40	7.4	7.6	0.2	0.57	100	100
22	JC1720	175	100	-75	3.9	5.5	1.6	0.62	100	100
23	JC1720	200	100	-100	2.5	9.3	6.8	0.76	81.6	-118
								avg =	**97.4**	**68.8**
17A	SC 50	25	100	75	32.2	181	149	0.12	75.0	8.3
18	SC 50	35	100	65	19.8	194	174	0.34	100	-35.3
19	SC 50	20	100	80	29.4	500	471	0.35	100	51.4
20	SC 50	45	90	45	5.2	11.9	6.7	1.37	100	100
21	SC 50	25	100	75	11.0	237	226	0.57	100	15.8
22	SC 50	30	100	70	12.1	87.7	75.6	0.62	100	82.3
23	SC 50	130	100	-30	4.7	6.2	1.5	0.76	81.6	81.6
								avg =	**93.8**	**43.4**
17A	A-100	1.20	2.00	0.80	15.0	18.3	3.3	0.12	100	100
18	A-100	0.50	1.00	0.50	33.2	56.7	23.5	0.34	100	100
19	A-100	2.75	4.00	1.25	17.1	51.3	34.2	0.35	100	100
20	A-100	10.00	13.00	3.00	11.2	12.2	1.0	1.37	100	94.2
21	A-100	0.35	0.60	0.25	35.3	69.1	33.8	0.57	89.5	80.7
22	A-100	4.00	8.00	4.00	8.7	68.3	59.6	0.62	82.3	71.0
23	A-100	1.00	8.00	7.00	20.5	140	120	0.76	53.9	51.3
								avg =	**89.4**	**85.3**
17A	SoilFix IR	0.80	1.30	0.50	28.3	31.1	3.0	0.12	75.0	75.0
18	SoilFix IR	0.20	1.00	0.80	55.2	121	66	0.34	100	50.0
19	SoilFix IR	1.60	2.00	0.40	48.1	75.5	27	0.35	100	100
20	SoilFix IR	7.00	10.00	3.00	21.2	40.8	20	1.37	93.4	93.4
21	SoilFix IR	0.10	1.00	0.90	67.6	166	98	0.57	77.2	45.6
22	SoilFix IR	2.50	4.00	1.50	33.6	80.2	47	0.62	79.0	75.8
23	SoilFix IR	0.50	4.00	3.50	42.9	152	109	0.76	56.6	68.4
								avg =	**83.0**	**72.6**

5.4 Chemically-Enhanced Sedimentation Experiments

Seven sets of sedimentation rate experiments were conducted in Phase IV (Experimental Runs 17A through 23). In each experiment, separate sedimentation tanks were filled with storm water dosed with either PAX-XL9, Jenchem 1720 or Superfloc A-100. A control tank without chemical was tested alongside the chemically-dosed tanks. A description of the tanks and an operational summary is presented in Section 3.4.1. Information on the storm water source, storm water quality and date collected were presented in Table 4-2. Chemical dose used in each tank was the BTD identified in the standard mixing jar test experiments. After filling, the sedimentation tanks were monitored for turbidity and phosphorus removal over time. Results of the sedimentation experiments are discussed below.

5.4.1 Settling Tank Doses

Target chemical doses used in the sedimentation experiments were determined from jar test runs conducted the previous day. Target versus actual dose was calculated by measuring the volume of chemical consumed after filling was complete. Listed in Table 5-51 are both the target chemical dose and the actual dose for each experiment. In all cases the variation between actual and target dose was less than 10 percent.

Table 5-51. Summary of Coagulant Doses Used in the Sedimentation Experiments

Run	Chemical	Target Dose (BTD) (mg/L)	Actual Dose (mg/L)
17A	PAX-XL9	70	70
	JC1720	120	120
	Superfloc A-100	1.2	1.2
	PAX-XL9	100	100
18	JC1720	80	80
	Superfloc A-100	0.50	0.52
	PAX-XL9	100	105
19	JC1720	30	32
	Superfloc A-100	2.75	2.75
	PAX-XL9	290	290
20	JC1720	240	240
	Superfloc A-100	10.00	9.82
	PAX-XL9	90	92
21	JC1720	100	100
	Superfloc A-100	0.35	0.35
	PAX-XL9	125	125
22	JC1720	175	174
	Superfloc A-100	4.00	3.96
	PAX-XL9	250	247
23	JC1720	200	201
	Superfloc A-100	1.00	0.99

5.4.2 Turbidity Removal

Turbidity and total and dissolved phosphorus of the dosed storm water inside the settling tanks was monitored five different times in the span of 8 hours at two different sampling depths. Samples were collected at time 0, 15 and 30 minutes, 1 and 8 hours after the filling cycle was completed. Samples were collected at Ports A (12 inches below the water surface) and D (48 inches below the water surface). Prior to emptying the settling tanks the following day an additional set of samples was collected for turbidity analyses.

Turbidity data for the sedimentation tank experiments are tabulated in Appendix F. Listed in each of the tables is the “mean initial turbidity” of the influent water used. Graphs of turbidity versus settling time for each tank and experimental run are included in Appendix G. Each graph has a small inset graph to show the full 24-hour turbidity monitoring period. Turbidities at the two tank depths are shown on the graphs using colored lines (blue for Port A and red for Port D). A horizontal dashed line at 20 NTU is shown on each graph to mark the Tahoe Basin turbidity limit for discharge to surface water. A graph typical of those in Appendix G is shown in Figure 5-20.

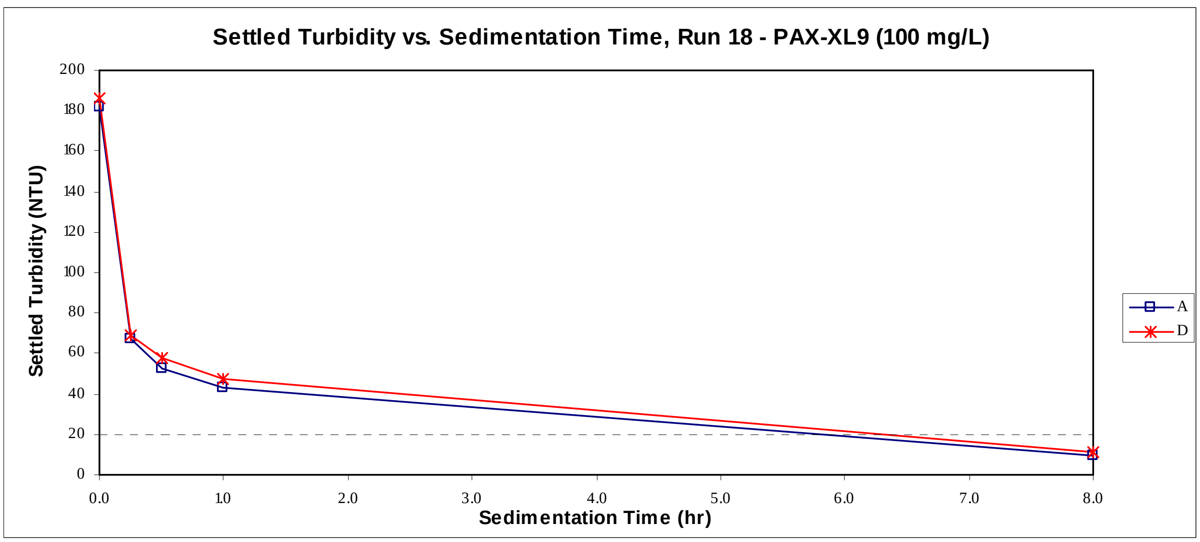


Figure 5-20. Typical Sedimentation Experiment Graph of Turbidity vs. Time

The initial (T_0) sample for turbidity analysis was collected from each sampling port as soon as the tank was completely filled (9.5 minutes fill time). In some of the samples collected (data in Appendix F), it is evident that floc settling occurred prior to T_0 sample collection (see Figure G-12). In a few of the sedimentation experiments, the T_0 turbidity values ranged from values higher than the influent turbidity at the lower port (D) to substantially reduced values at the upper port (A), indicating that sedimentation was already in progress. The T_0 samples, therefore, may not represent the true starting point in the sedimentation experiments. In most runs, there was little difference in turbidity measured at the two sampling depths (little separation between the lines on the graphs). This observation has been noted in previous project phases as well.

The two PAC chemicals (JC1720 and PAX-XL9) were very effective in reducing turbidity to below the 20 NTU limit within 8 hours of settling. For all runs, the majority of turbidity removal occurred within the first hour. In many of the runs, the PAM product (Superfloc A-100) was only slightly better than the control in reducing turbidity. Using the turbidities measured at Port D (4 feet below the surface), the settling times required to meet the 20 NTU benchmark were determined or estimated by linear interpolation or extrapolation. The results are presented in Table 5-52.

Table 5-52. Estimated Time Required for Chemical Enhanced Sedimentation (Port D) Effluent to Meet the Turbidity Limit (20 NTU)

Chemical	Estimated Time Required (hours) to Attain a Turbidity of 20 NTU (listed by Run)							
	17A	18	19	20	21	22	23	Average
PAX-XL9	6.7	6.3	9.5	5.5	5.4	6.3	0.7	5.8
JC1720	6.6	6.8	7.2	5.6	5.8	6.5	1.9	5.8
A-100	36.6	44	82	50	45	44	50	50
Control	229	63	146	29	59	40	123	98

With the doses and storm waters used, the PAC products (JC1720 and PAX-XL9) generally demonstrated similar abilities to reduce turbidity. Both JC1720 and PAX-XL9 required an average (n = 7) of 5.8 hours to reduce the turbidity (Port D) to less than 20 NTU. By extrapolation, it is estimated that Superfloc A-100 (PAM) would have required an average of 50 hours to effect similar removal.

It should be noted that, in the chemically-enhanced settling experiments, mixing (of the chemical with the storm water) was limited to a single, in-line static mixer (Komax® AP-1.5-4) to obtain rapid mixing of the chemical. Unlike the jar tests, there was no “slow mixing” step to enhance floc formation. SuperFloc A-100 performed reasonably well in the jar tests put poorly in the settling experiments. It is possible that A-100 is more sensitive to mixing, or the type of mixing that occurred in the static mixer. Additionally, higher floc settling velocities are required in the settling tanks (6 inches in the jars, 48 inches in the sedimentation tanks, for any given time). A slower falling (less dense) floc would require additional time in the sedimentation tanks to reach an equivalent turbidity measured in the jar study. It is thought, however, that sedimentation tank experiments are more representative of full-scale (field) performance because of the limited mixing and the distance the floc must fall for sedimentation.

5.4.3 Phosphorus Removal

Samples for total and dissolved phosphorus analyses were collected from both sample ports at times 0, 0.25, 0.5, 1 and 8 hours. Results of the phosphorus analyses are included in Appendix F. Samples for phosphorus analyses were not collected at 24 hours.

Both PAX-XL9 and JC1720 were able to reduce the total phosphorus concentration of the settled storm water (at Port D) to below the limit required for surface water discharge (0.1 mg-P/L) in six of seven runs (failing only in Run 22). In all but Run 22, JC1720 reduced the total phosphorus concentration to below the reporting limit (0.03 mg-P/L) within 8 hours. The PAX-XL9 reduced the total phosphorus concentration to below the reporting limit in five of seven runs within 8 hours (the end of monitoring for phosphorus). Superfloc-100 (PAM) was able to reduce the phosphorus to the Tahoe Basin limit of 0.1 mg-P/L only two of seven runs. The sampling time that the total phosphorus level was reduced to the limit of 0.1 mg-P/L and the turbidity at that time for each test are summarized in Table 5-53.

Table 5-53. Time Required for the Sedimentation Tank Effluent to be Reduced Below the Total Phosphorus Limit for Surface Discharge (0.1 mg-P/L)

Run Information								
	Exp. Run #	17A	18	19	20	21	22	23
	Initial SW Turbidity (NTU)	170	191	841	1,764	256	408	316
	Initial SW Phos-T (mg/L)	0.12	0.13	0.51	1.24	0.47	0.61	0.48
Chemical								
PAX-XL9	Time (hr) to reach 0.1 mg/L	0.25	8	0.25	1	8	N	8
	Turb (NTU) at that time	91	11.5	123	36.3	7.1	-	2.9
JC1720	Time (hr) to reach 0.1 mg/L	0	8	0.25	0.25	1	N	1
	Turb (NTU) at that time	166	12.3	85.5	47.5	50.2	-	22.5
A-100	Time (hr) to reach 0.1 mg/L	0	N	0.5	N	N	N	N
	Turb (NTU) at that time	153	-	232	-	-	-	-
Control	Time (hr) to reach 0.1 mg/L	0	N	N	N	N	N	N
	Turb (NTU) at that time	156	-	-	-	-	-	-

In many cases, JC1720 was able to reduce the total phosphorus concentration to below 0.1 mg-P/L faster than PAX-XL9. Not considering Run 17A when the Phos-T concentration was low, the average turbidity of the water in the JC1720 settling tank was 43.6 NTU at the time the phosphorus concentration was <0.1 mg-P/L. The average turbidity in the PAX-XL9 tank was 36.2 at the time the Phos-T concentration was reduced to below 0.1 mg-P/L. This indicates that turbidity in excess of the Tahoe Basin discharge benchmark of 20 NTU may have a total phosphorus concentration below the limit of 0.1 mg-P/L.

Chapter 6

Summary of Findings

Chapter 6 Summary of Findings

Key findings from Phase IV of the Caltrans Lake Tahoe Storm Water Small-Scale Pilot Treatment Project are summarized in this chapter. Suggestions for future small-scale testing are also discussed.

6.1 Summary of Findings

In Chapter 5, the results of the Phase IV testing program are presented in detail, arranged according to the three major components of the work, namely: 1) the 4-inch filter columns, 2) the jar tests, and 3) the chemically-enhanced sedimentation experiments. Key findings resulting from each of these areas of investigation are presented below.

6.1.1 4-Inch Filter Columns

In Phase IV, eighteen 4-inch filter columns containing nine different media were loaded with clarified storm water during seven experimental runs. Storm water collected was generally representative of typical Tahoe Basin runoff, however after clarification, the water was even lower in the key parameters (turbidity, TSS, phos-T). Media evaluated included the existing fine sand (F-105) and 28x48 mesh activated alumina filter columns from Phase III, new 28x48 mesh activated alumina, 14x28 mesh activated alumina, Superior 30 sand, limestone, iron-modified activated alumina, granular ferric hydroxide and Bayoxide E-33.

Treatment Performance

Listed in Table 6-1 are the numbers of times that the column media pairs were able to produce an effluent at or below the limit required in the Tahoe Basin (LRWQCB or TRPA) for the upcoming regulated constituents. Summarized in Table 6-2 are the calculated average percent removals (load reductions) for monitored constituents of the column pairs for the seven experimental runs. Summarized in Table 6-3 are the average (n = 14) effluent concentrations of the column pairs for the same constituents.

Filter media performance was ranked by percent removals of turbidity, total phosphorus and total nitrogen, and then those constituent-specific rankings were averaged to obtain a combined ranking for contaminant removals (Table 5-39). The actual percent removals (not the rankings) for the three constituents also were averaged (Table 5-39). Iron-modified activated alumina, when operated at a bed depth of 24 inches (Runs 18-22) was the highest ranked media tested (and had the greatest average percent removal). The second highest ranked media was the 28x48 mesh activated alumina, regardless of its condition and relative age (Phase III or Phase IV media). The larger grain size activated alumina (14x28 mesh) was fourth in the contaminant removal ranking, but had the second highest overall average percent removal. The two sand media (Superior 30 and F-105) and the limestone, while still removing above 60 percent of the constituents (averaged), are the lowest ranked media with regard to contaminant removals.

Table 6-1 Summary of Phase IV 4-Inch Filter Column Performance – Removal Relative to Tahoe Basin Discharge Limits

Col #	Media	Meets Infiltration Discharge Limit[a]					Meets Surface Water Discharge Limit[a]				
		Turb	Tot-P	Tot-N	Fe-T	TSS	Turb[a]	Tot-P	Tot-N	Fe-T	TSS
-	Raw Storm Water	1 of 7	6 of 7	7 of 7	0 of 7	NL	0 of 7	0 of 7	1 of 7	0 of 7	1 of 7
-	Clarifier Effluent	3 of 7	7 of 7	7 of 7	2 of 7	NL	0 of 7	1 of 7	1 of 7	0 of 7	5 of 7
1 and 2	Existing Activated Alumina (28x48)	14 of 14	14 of 14	14 of 14	NM	NL	13 of 14	13 of 14	12 of 14	NM	14 of 14
3 and 4	Existing Sand (F-105)	14 of 14	14 of 14	14 of 14	NM	NL	0 of 14	7 of 14	13 of 14	NM	14 of 14
5 and 6	Activated Alumina (28x48 mesh)	14 of 14	14 of 14	14 of 14	NM	NL	9 of 14	13 of 14	11 of 14	NM	14 of 14
7 and 8	Activated Alumina (14x28 mesh)	14 of 14	14 of 14	14 of 14	NM	NL	6 of 14	14 of 14	13 of 14	NM	14 of 14
9 and 10	Superior 30 Sand	14 of 14	14 of 14	14 of 14	12 of 14	NL	0 of 14	6 of 14	9 of 14	0 of 14	14 of 14
11 and 12	Limestone (#4 Limestone Sand)	14 of 14	14 of 14	14 of 14	14 of 14	NL	0 of 14	7 of 14	11 of 14	0 of 14	14 of 14
15 and16	Granular Ferric Hydroxide	14 of 14	14 of 14	14 of 14	14 of 14	NL	12 of 14	12 of 14	9 of 14	12 of 14	14 of 14
17 and18	Bayoxide E-33 (Iron Oxide)	14 of 14	14 of 14	14 of 14	14 of 14	NL	5 of 14	12 of 14	10 of 14	5 of 14	14 of 14
13 and 14	Fe-Modified Activated Alumina										
	Runs 18-22, 24” bed depth	10 of 10	10 of 10	10 of 10	10 of 10	NL	10 of 10	8 of 10	10 of 10	10 of 10	10 of 10
	Runs 23-24, 12” bed depth	4 of 4	4 of 4	4 of 4	4 of 4	NL	0 of 4	4 of 4	2 of 4	0 of 4	4 of 4

NL No limit established NM Not measured

[a] Limits established by the LRWQCB (1994) as “total” constituents except for TSS in which the limit is based on TRPA discharge standards

[b] Turbidity measured in the effluent sample collected for water quality analyses

Table 6-2 Summary of Phase IV 4-Inch Filter Column Performance – Average Percent Load Reduction

Col #	Media	Average Percent Removal									
		Turb[a]	TSS	Phos-T	Phos-D	Tot-N	TKN-D	Fe-T	Al-T	Al-D	Al-AS
-	Clarifier Effluent	39.0	60.6	36.6	-3.1	-43.9	-95.5	36.8	34.3	175	-48.6
1 and 2	Existing Activated Alumina (28x48)	96.6	92.3	96.6	90.2	62.3	57.7	NM	95.2	64.5	88.5
3 and 4	Existing Sand (F-105)	74.2	85.9	63.4	25.7	71.2	-66.2	NM	54.5	11.5	36.4
5 and 6	Activated Alumina (28x48 mesh)	95.6	96.1	95.5	83.0	65.1	75.2	NM	92.3	-249	63.4
7 and 8	Activated Alumina (14x28 mesh)	89.2	94.2	92.4	83.9	76.8	-23.8	NM	83.0	-371	25.0
9 and 10	Superior 30 Sand	72.8	85.4	62.1	38.0	49.2	-131	69.3	68.7	100	22.9
11 and 12	Limestone (#4 Limestone Sand)	74.6	87.4	60.0	26.2	53.8	-123	70.9	69.1	-130	24.2
15 and 16	Granular Ferric Hydroxide	96.3	95.0	88.2	82.1	43.3	36.3	96.1	95.8	-14.7	73.0
17 and 18	Bayoxide E-33 (Iron Oxide)	86.2	93.1	88.4	83.0	51.6	-40.9	84.8	84.1	19.1	43.1
13 and 14	Fe-Modified Activated Alumina										
	Runs 18-22, 24” bed depth	99.7	98.0	90.7	73.2	87.7	79.8	99.9	99.9	100	99.6
	Runs 23-24, 12” bed depth	76.9	85.4	100	100	7.0	60.5	74.0	73.1	100	100

NM Not measured

[a] Turbidity as measured in the effluent sample collected for water quality analyses

Table 6-3 Summary of Phase IV 4-Inch Filter Column Performance – Average Effluent Concentration

Col #	Media	Average Effluent Concentration									
		Turb[a]	TSS	Phos-T	Phos-D	Tot-N	TKN-D	Fe-T	Al-T	Al-D	Al-AS
		(NTU)	(mg/L)	(mg-P/L)	(mg-P/L)	(mg-N/L)	(mg-N/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
-	Clarifier Effluent	325	158	0.35	0.12	1.07	0.30	7,660	5,083	54.1	360
1 and 2	Existing Activated Alumina (28x48)	7.2	5	<0.03	<0.03	0.27	0.10	NM	177	<25	52
3 and 4	Existing Sand (F-105)	82.5	21	0.15	0.18	0.31	0.18	2,143	2,988	<25	218
5 and 6	Activated Alumina (28x48 mesh)	12.4	5	<0.03	0.04	0.27	0.13	NM	301	54	85
7 and 8	Activated Alumina (14x28 mesh)	37.0	11	0.04	0.03	0.25	0.12	NM	798	64	162
9 and 10	Superior 30 Sand	88.7	20	0.16	0.16	0.47	0.32	NM	1,561	<25	214
11 and 12	Limestone (#4 Limestone Sand)	82.4	12	0.16	0.18	0.43	0.28	2,046	1,470	30	223
15 and 16	Granular Ferric Hydroxide	8.1	5	0.05	0.04	0.41	0.14	213	161	<25	54
17 and 18	Bayoxide E-33 (Iron Oxide)	51.3	11	0.05	0.04	0.42	0.20	1,260	890	<25	139
13 and 14	Fe-Modified Activated Alumina										
	Runs 18-22, 24” bed depth	0.7	3	0.04	<0.03	0.18	0.12	<25	<25	<25	<25
	Runs 23-24, 12” bed depth	62.8	22	<0.03	<0.03	0.46	0.10	1,690	1,320	<25	<25

NM Not measured

[a] Turbidity as measured in the effluent sample collected for water quality analyses

Hydraulic Performance

Hydraulic performances of the media are summarized in Table 5-40 in Chapter 5. The best performing media from a hydraulic standpoint was the 14x28 mesh activated alumina, filtering slightly more water before sand cap replacement than the existing F-105 sand. The 14x28 mesh activated alumina filters handled an average hydraulic loading equal to 1.8 years of full-scale operation before sand cap replacement or other intervention was required. However, the turbidity and suspended solids loads handled to hydraulic failure were equivalent to only 1.2 and 0.36 years of full-scale operation. The finer grain activated alumina, the iron-modified activated alumina and the GFH filtered the least amount of storm water between interventions to restore flow. For these media, equivalent annual hydraulic, turbidity, and TSS loads between interventions ranged from 0.6 to 0.9, 0.35 to 0.54, and 0.10 to 0.17, respectively. The equivalent annual loadings are based on a full-scale filter receiving 90 feet (applied depth) of storm water per year at typical Tahoe Basin storm water constituent concentrations. Although actual experience with full-scale filters indicates hydraulic performance in the field may be better than in the small-scale pilot tests, the loadings sustained before hydraulic failure may be of concern for media filters.

Media Side Effects

Filtration through limestone and 28x48 mesh activated alumina (new and existing) media resulted in moderate increases in storm water pH, averaging about 0.5 and 0.3 units, respectively. The average increase in effluent pH was the same for the activated alumina, whether new or old; however the net increase measured in Phase IV (0.3 pH units) was less than observed in Phase III (0.6 pH units).

Coarse mesh (14x28) mesh activated alumina had essentially no effect on storm water pH, as did the sand media (F-105 and Superior 30) and the Bayoxide. The iron-modified activated alumina media resulted in an average pH decrease of 0.85 units (larger impact with new media and diminishing with use), while the GFH media reduced the pH an average of 2.1 units. The average effluent pH from the GFH filters was around 5.3, which is below the Basin Plan objective of 6.5 for receiving waters.

Leaching of dissolved aluminum from new activated alumina (both grain sizes) and limestone media was observed in Phase IV as in previous phases. However, no increase in dissolved aluminum concentrations was noted for the existing 28x48 mesh activated alumina filters that were continued in operation from Phase III. Apparently, the leaching of dissolved aluminum diminishes with use.

6.1.2 Jar Test Experiments

Jar test experiments were conducted in seven separate runs using six different water treatment chemicals (PASS-C, PAX-XL9, Jenchem 1720, SumalChlor 50, Superfloc A-100 and Soilfix IR) and three different testing conditions (standard mixing, mixing sensitivity and temperature sensitivity). Key findings from the jar test experiments are summarized below:

- The polyaluminum chloride (PAC) coagulants PASS-C, PAX-XL9 and Jenchem 1720 were the most effective chemicals for turbidity reduction in the jar tests. Jenchem 1720 (JC1720) was able to attain the 20 NTU treatment benchmark after 15 minutes of jar settling for all seven storm waters.

- PASS-C and PAX-XL9 reduced the storm water turbidity to below the 20 NTU benchmark within 15 minutes of settling in 6 of 7 and 5 of 7 trials, respectively. In Phase III, both coagulants were able to attain the 20 NTU level in 7 of 9 trials.

- PASS-C and PAX-XL9 were always able to reduce the turbidity to less than 20 NTU after one hour of settling and generally to less than 20 NTU after 15 minutes, with a few exceptions.

- SumalChlor 50 was the least effective PAC product tested. After 15 minutes of settling, the SumalChlor 50 attained the turbidity benchmark in only two of seven runs (five of seven after one hour of settling).

- Cytec Superfloc A-100 was the more effective of the two anionic polyacrylamide (PAM) products tested. Superfloc A-100 was able to reduce the turbidity in the jars to <20 NTU in five of seven runs within 15 minutes. The SoilFix IR product was never able to attain treatment below 20 NTU.

- A dose of PAX-XL9 or PASS-C of approximately 100-110 mg/L provided treatment to below 20 NTU in nearly all storm waters tested (under the standard jar testing conditions used). A set dose somewhere between 25 and 115 mg/L of JC1720 would have provided treatment to below 20 NTU in all seven runs. SumalChlor 50 and SoilFix IR were relatively ineffective in turbidity removals, and no common doses were able to provide effective treatment for the storm waters tested. Superfloc A-100 was reasonably effective in turbidity removal in Phase IV, however no single effective dose could be identified that would treat all of the storm waters tested.

- Considerable improvement in settled turbidity with additional settling time was observed in the standard mixing jars. Turbidities after one hour of settling for the PAX-XL9, PASS-C, and SumalChlor 50 dosed jars were typically 50 percent lower than after 15 minutes of settling. Turbidities of the JC1720 dosed jars, which were quite good after only 15 minutes, improved an average of 38 percent after an additional 45 minutes of settling. Both of the PAM products exhibited the least improvement in turbidity removal with additional settling time.

- On the average, the final settled turbidity after 15 minutes of the BTD was approximately 50 NTU higher in the mixing sensitivity jars than in the standard mixing jars for PAX-XL9, PASS-C and JC1720. After one hour of settling, the difference between the two mixing scenarios decreased to about 25 NTU for the same chemicals. At times the overall range of treatment was narrower in the mixing sensitivity jars than observed under standard mixing conditions.

- On the average, there was very little difference in settled turbidity with water temperature. For PASS-C, PAX-XL9 and JC1720 the average difference between the standard mixing runs at ambient temperature and the cold jars after 15 minutes of settling was less than 10 NTU, with the difference even smaller after one hour of settling. As with the other chemicals tested, there was little difference in the performance of the PAM products due to water temperature. If anything, the performance may be slightly better at colder water temperatures.

- The removal of total phosphorus in the PAC dosed jars after one hour of settling averaged between 93.8 to 97.4 percent. The JC1720 had the highest percent removal of total phosphorus (Phos-T), removing an average (n = 7) of 97.4 percent. Average Phos-T percent removal at the best turbidity dose (BTD) was 97.0 percent for the PAX-XL9, 93.9 percent for the PASS-C and 93.8 percent for the SumalChlor 50. The data for removal of dissolved phosphorus (Phos-D) are more limited, but on average (n = 3) the PAC chemicals removed 100 percent of the Phos-D. In general, the PAM products are less successful in removing total and dissolved phosphorus.

- In addition to the BTD jar, in each run a second jar was selected for phosphorus sampling after one hour of settling. The second jar was typically the 100 mg/L dosed jar, except when the BTD was 100 mg/L. In that case, another jar was selected. In all cases, the average (n = 7) percent removals for doses different than the BTD (both higher and lower) were not as good as those measured for the BTD.

6.1.3 Chemically-Enhanced Sedimentation Experiments

Seven sets of sedimentation rate experiments were conducted in Phase IV. In each experiment, separate sedimentation tanks were filled with storm water dosed with either PAX-XL9, Jenchem 1720 or Superfloc A-100. A control tank without chemical was tested alongside the chemically-dosed tanks. Key findings from the sedimentation experiments are summarized below:

- The two PAC chemicals (Jenchem 1720 and PAX-XL9) were very effective in reducing turbidity to below the Tahoe Basin surface water discharge limit (20 NTU). Both JC1720 and PAX-XL9 required an average (n = 7) of 5.8 hours to reduce the turbidity to less than 20 NTU. For all runs, the majority (80-90 percent) of turbidity removal occurred within the first hour. In Phase III, PASS-C and PAX-XL9 were both able to reduce the storm water turbidity to below 20 NTU after 2 to 6 hours of settling (4 trials).

- In many of the runs, the best performing PAM product (Superfloc A-100) was only slightly better than the control in reducing turbidity in the sedimentation tank experiments. The Superfloc A-100 required an average of 50 hours (extrapolated) to reduce the turbidity to 20 NTU. The reason that this chemical performed worse in the settling tank compared to the jar test experiments is unknown, but perhaps due to the lack of a slow mixing step and low density floc particles.

- Both PAX-XL9 and JC1720 were able to reduce the total phosphorus concentration of the settled storm water to below the limit required for surface water discharge (0.1 mg-P/L) in six of seven runs (failing only in Run 22). In all but Run 22, JC1720 reduced the total phosphorus concentration to below the reporting limit (0.03 mg-P/L) within 8 hours. PAX-XL9 reduced the total phosphorus concentration to below the reporting limit in five of seven runs within 8 hours (the end of monitoring for phosphorus). The Superfloc A-100 product was able to reduce the phosphorus to the Tahoe Basin limit of 0.1 mg-P/L in only two of seven runs.

6.2 Conclusions

Based on the findings presented above, the following conclusions are made:

1. Iron-modified activated alumina demonstrated excellent treatment performance. It was the best media for turbidity (99.7 percent), TSS (98.0 percent), total nitrogen (87.7 percent), iron (99.9 percent) and aluminum (99.9 percent) removals. The removal of phosphorus was also good (90.7 percent). However, iron-modified activated alumina had the worst hydraulic performance. In this study, the 4-inch filter columns containing the iron-modified activated alumina required the most interventions (i.e. sand cap and media replacements) to maintain flow. Hydraulic, turbidity, and TSS loads handled between interventions to restore flow were equivalent to only 0.6, 0.35, and 0.1 years of full-scale operation, respectively.

2. As observed in previous phases of this study, the 28x48 mesh DD-2 activated alumina continues to outperform most other media with regard to treatment performance. Both new and existing materials from Phase III were tested side-by-side, with little observable differences. Whether new or old, 28x48 mesh activated alumina removed 96-97 percent of the turbidity, 92-96 percent of TSS, 62-65 percent of the total nitrogen and 92-95 percent of the total aluminum. The 28x48 mesh DD-2 outperformed the iron-modified activated alumina in the removal of total phosphorus (96-97 percent). In the new material, some leaching/dissolution of dissolved aluminum was observed. This was not observed in the effluent of the existing material, indicating that with age, less dissolved aluminum in the effluent can be expected. A slight increase (0.3 units) in pH was measured in the effluents of both the new and old media. Between interventions (to restore flow) the new 28x48 mesh activated alumina handled hydraulic, turbidity, and TSS loads equivalent to only 1.1, 0.55, and 0.17 years of full-scale operation, respectively. However, a similar propensity for hydraulic failure has not been observed in the full-scale pilot filters. As observed in Phase III, disadvantages associated with activated alumina include poor hydraulics and elevated effluent pH and dissolved aluminum levels.

3. Alternate mesh activated alumina (14x28) was less effective from a treatment standpoint than the smaller 28x48 mesh activated alumina, but still removed a considerable percentage of the key constituents (89 percent removal of turbidity, 94 percent of TSS, 92 percent total phosphorus). As observed with the finer material, some leaching/dissolution of aluminum was noted; however, there was no increase in pH. The 14x28 mesh activated alumina exhibited the best hydraulic performance of all the media tested, requiring the least interventions to restore flow. Between interventions to restore flow, the new 28x48 mesh activated alumina handled hydraulic, turbidity, and TSS loads equivalent to only 1.8, 1.2, and 0.36 years of full-scale operation, respectively. When treatment and hydraulic performance are considered together, the 14x28 mesh activated ranked high in the pilot study.

4. Granular ferric hydroxide (GFH) media performed well, but not as good as the various activated alumina media. Filtration with GFH removed 96 percent of the influent turbidity, 95 percent of the TSS, 88 percent of the total phosphorus, 43 percent of the total nitrogen, 96 percent of the total iron and 96 percent of the total aluminum. The most significant disadvantage is that GFH decreases the storm water pH by an average of 2 pH

units. Several of the effluents were well below the Basin Plan objective for pH (6.5). An increase in effluent dissolved aluminum was noted (likely due to the low pH). Also, the GFH media performed poorly with respect to hydraulics (worse than the new 28x48 mesh activated alumina).

5. The proprietary Bayoxide E-33 media performed better than the sand or limestone media, but was not overly impressive. The Bayoxide removed 86 percent of the turbidity, 88 percent of the total phosphorus and 52 percent of the total nitrogen. No increase in iron was detected in the effluent, even though this media is primarily pure iron oxide. This media ranked near the middle of all media tested with respect to hydraulic performance and the level of effort required to maintain flow.

6. The remaining media (limestone, Superior 30 sand, and the existing F-105 sand) perform poorly with respect to constituent removals, as compared to the other media evaluated. However, in general they outperformed most other media (except 14x28 mesh activated alumina) hydraulically. The limestone and sand media removed 72-74 percent of the turbidity load, 85-87 percent of the TSS, 60-63 percent of the total phosphorus, and 50-71 percent of the total nitrogen. Although, these media were not able to meet the numerical limits for discharge to surface waters within the Tahoe Basin, they did accomplish substantial load removals and may have some potential from a TMDL standpoint.

7. PASS-C, PAX-XL9 and Jenchem 1720 were the most effective chemicals evaluated in the jar tests to remove turbidity and phosphorus from the storm water. The JC1720 slightly outperformed the others by removing turbidity to below the 20 NTU benchmark after 15 minutes of settling for all storm waters tested. Additionally, the JC1720 demonstrated superior removal of phosphorus (97.4 percent) in the jar testing.

8. Water temperature had little effect on the performance of the coagulants tested. However, elimination of slow mixing had a large effect on both final settled turbidity and the range of effectiveness after 15 minutes of settling. The performance gap closed somewhat after an additional 45 minutes of settling.

9. In the settling tests, which have limited mixing similar to conditions expected in the field, both JC1720 and PAX-XL9 were able to reduce the turbidity to below 20 NTU after an average of 5.8 hours of settling. Phosphorus was reduced to below the 0.1 mg-P/L required for surface discharge in six of seven runs after 8 hours of settling using JC1720 and PAX-XL9. In many runs, the PAM product (Superfloc A-100) was only slightly better than the control.

10. Phosphorus addition to the bulk storm water allowed conclusions, determinations and assessments of Phos-D removal efficiency in the various systems possible; since Phos-D was only present in the storm water when added (in 4 of 7 runs). In any particular run, some treatments were able to reduce the levels of Phos-D while others were not. Therefore, it is believed that adding low levels sodium phosphorus to the storm water provided a suitable simulation of soluble phosphorus which was absent in the storm water collected.

6.3 Potential Future Testing Activities

Based on the findings and conclusions presented above and the desire to establish practical alternative field treatments for storm water runoff, the following may be considered for future testing at the Lake Tahoe Storm Water Small-Scale Pilot Treatment Facility:

A. Granular Media Investigations

1. Testing of various pretreatment (prior to filtration) methods, filter media grain sizes, and filter loading rates. Because of site constraints in most roadway runoff situations, there is a need to develop higher rate and smaller foot-print filters than those currently being implemented on a full-scale basis. This will require higher hydraulic loading rates than those investigated in this study. To sustain higher filter loading rates, larger media grain sizes and improved pretreatment (prior to filtration) methods should be considered. The effect of these variables on treatment performance can be determined.
2. Identification and testing of new alternate media that may be suitable for storm water filtration.
3. Evaluation of the utility of layering different types of sorptive media. It is thought that some of the undesirable "side effects" such as elevated pH could be mitigated using one media to raise the pH followed by a second media layer that lowers pH.
4. Evaluation of the benefits of using sand caps on top of other filter media. Sand caps have been used in the filters tested to date, but they have not been completely successful in protecting the underlying media from fouling.

B. Chemical Treatment of Storm Water

1. Study the settling characteristics of chemically-enhanced storm water at doses other than optimal. Many of the polyaluminum chloride coagulants have a wide range of effectiveness but little is known about the performance at the fringes of treatment.
2. Additional assessments of the potential aquatic toxicity ramifications of chemical treatment. Multi-species toxicity testing of chemically-treated storm water (various chemicals) and resultant solids residues would be useful.
3. Investigation of streaming current detection as an indicator of appropriate chemical dose.
4. Particle size investigations to help in the understanding of turbidity and other contaminant removal mechanisms.

Appendix A

Quality Control

Appendix A Quality Control

PHASE IV QUALITY CONTROL REVIEW PROCEDURES

Data collected during the testing and operation of the various storm water treatment units must be of sufficient quality to support the project goals. Specific, numeric data quality objectives (DQOs) were established in the project Sampling and Analysis Plan (SAP, Section 3 of the PIV Monitoring and Operation Plan). Various assessments (outlined in the following sections) of the data were made.

Data Review Components:

1. Electronic validation using the Caltrans Laboratory EDD Processing
2. Data completeness
3. Compliance with specified analytical methods
4. Holding time and sample preservation
5. Blanks
6. Laboratory control samples (LCS)
7. Matrix spike/matrix duplicates
8. Laboratory duplicates
9. Field duplicates
10. Total/dissolved comparison
11. Performance evaluation samples
12. Analyte quantification/reporting limits

Electronic Validation using the Caltrans Laboratory EDD Processing Tool

The contract laboratory (Pat-Chem, Moorpark, CA) was required to provide data in both hard copy and electronic formats (Caltrans EDD format). The EDD was required to have been processed using the Caltrans "error checker" tool to ensure the EDD format was correct and that lab QC samples were within acceptable ranges. Additionally, the contract laboratory provided complete QC documentation. The review of lab QC is outlined in subsequent sections.

Data Completeness

At the time of QC review, the lab report is checked against the C-of-C form listing requested parameters for sample analysis. Any sample analysis requested and not performed (or reported) by the laboratory is noted. Additionally, any samples lost or damaged in shipping to the extent that insufficient sample remains or that the sample itself is compromised, is noted. At the end of the project, completeness will be determined by dividing the number of data points intended for collection by the number of data points actually received or recorded.

Compliance with Specified Analytical Methods

Lab reports were reviewed for compliance with the specified analytical method for each parameter measured. Required analytical methods were specified in Table 3-1 of the Monitoring and Operations Plan and are summarized in Table A-1.

Table A-1. Required Project Analytical Methods

Parameter	Abbreviation	Analytical Method
Alkalinity – Total	Alk -T	EPA 310.1
Total Suspended Solids	TSS	EPA 160.2
Volatile Suspended Solids	VSS	EPA 160.4
Nitrate + Nitrite Nitrogen	$NO_3 + NO_2$	EPA 353.2
Total Kjeldahl Nitrogen (Filtered)	TKN (D)	EPA 351.3
Total Kjeldahl Nitrogen (Un-Filtered)	TKN (T)	EPA 351.3
Total Phosphorus (Filtered)	Phos (D)	EPA 365.3
Total Phosphorus (Un-Filtered)	Phos (T)	EPA 365.3
Aluminum – Total	Al – T	EPA 200.8
Aluminum – Dissolved	Al – D	EPA 200.8
Aluminum – Acid Soluble	Al – AS	EPA 200.8
Iron – Total	Fe -T	EPA 200.7
Iron – Dissolved	Fe -D	EPA 200.7
Total Organic Carbon	TOC	EPA 415.1

Holding Time and Preservation

A review of the data was made with respect to compliance with approved holding times listed in the Caltrans Storm Water Monitoring Protocols Guidance Manual and also in the PIV M&O Plan (Table 3-1). A data quality objective of 99 percent (i.e., 99 percent of the project samples must be analyzed within approved sample holding times for each parameter) was established in the project's Monitoring and Operations Plan. Holding times are summarized in Table A-2. Note that holding times listed are for parameters properly preserved as outlined in Table 3-1 of the M&O Plan. Holding times are calculated from the time sample processing (field filtering and splitting) concludes to the beginning of analysis in the laboratory. Laboratory submittals were reviewed for holding time violations and results tabulated on a per run basis.

Data for samples analyzed outside of specified holding times were considered "estimated" and issued the "J" data qualifier. An "a" reason code was issued to data qualified for holding time violations.

Table A-2. Required Sample Holding Times

Parameter	Abbreviation	Holding Time
Alkalinity – Total	Alk -T	14 days
Total Suspended Solids	TSS	7 days
Volatile Suspended Solids	VSS	7 days
Nitrate + Nitrite Nitrogen	$NO_3 + NO_2$	28 days
Total Kjeldahl Nitrogen (Filtered)	TKN (D)	28 days
Total Kjeldahl Nitrogen (Un-Filtered)	TKN (T)	28 days
Total Phosphorus (Filtered)	Phos (D)	28 days
Total Phosphorus (Un-Filtered)	Phos (T)	28 days
Aluminum – Total	Al – T	180 days
Aluminum – Dissolved	Al – D	180 days
Aluminum – Acid Soluble	Al – AS	180 days
Iron – Total	Fe -T	180 days
Iron – Dissolved	Fe -D	180 days
Total Organic Carbon	TOC	28 days

Analyte Quantification/Reporting Limits

Laboratory results were reviewed for compliance with the required project reporting limits. Table A-3 lists the required reporting limits, which are consistent with the requirements set forth in the Storm Water Monitoring Protocols (Caltrans, 2000a).

Blanks

Several different types of blanks were used throughout this project to monitor contamination of the samples. Bottle blanks were prepared in the field by pouring certified HPLC grade water (Fisher or equivalent) directly into the sample containers, without the use of a secondary container and without filtering. Equipment blanks were also prepared in the field by rinsing randomly selected sampling equipment with de-ionized water and then processing the water like any other sample, including the filtration step. Laboratory blanks include reagent and method blanks and are prepared in the laboratory.

A sample result was qualified “U” (anomalous) if the result was within 5 times that of the associated blank. An “i” reason code was assigned for method blank contamination; “k” for equipment blank contamination; “m” for bottle blank contamination; and “o” for trip blank contamination.

Table A-3. Required Project Reporting Limits

Parameter	Abbreviation	Required Reporting Limit	Units
Specific Conductance	EC	1	µmho/cm
pH	pH	0.1	S.U
Turbidity	Turb	0.1	NTU
Temperature	Temp	1	°C
Alkalinity – Total	Alk -T	1	mg-$CaCO_3$/L
Total Suspended Solids	TSS	1	mg/L
Volatile Suspended Solids	VSS	1	mg/L
Nitrate + Nitrite Nitrogen	NO_3-N	0.1	mg-N/L
Total Kjeldahl Nitrogen (Filtered)	TKN (D)	0.1	mg-N/L
Total Kjeldahl Nitrogen (Un-Filtered)	TKN (T)	0.1	mg-N/L
Total Phosphorus (Filtered)	Phos (D)	0.03	mg-P/L
Total Phosphorus (Un-Filtered)	Phos (T)	0.03	mg-P/L
Aluminum – Total	Al – T	25	µg/L
Aluminum – Dissolved	Al – D	25	µg/L
Aluminum – Acid Soluble	Al – AS	25	µg/L
Iron – Total	Fe -T	25	µg/L
Iron – Dissolved	Fe -D	25	µg/L
Total Organic Carbon	TOC	1	mg/L

Laboratory Control Samples (LCS)

Laboratory control samples (LCS) are prepared in the laboratory. LCS are made by spiking known amounts (of analyte) into a clean matrix and are used to assess any matrix type effects on spike recoveries. Laboratory reports were reviewed for compliance of LCS recoveries with the recoveries specified in the Monitoring and Operations Plan and summarized in Table A-4 (accuracy column).

A sample result was qualified “U” (anomalous) if the result was outside the control limits. A “q” reason code was assigned for LCS outside specified limits.

Table A-4. Numerical Data Quality Objectives for Laboratory QC Samples

Parameter	Reporting Limit	Accuracy (% Recovery)	Precision	
			Matrix Spike (RPD)[a]	Duplicate (RPD)
Alkalinity	1 mg/L	80 – 120%	--	20%
Total Suspended Solids	1 mg/L	80 – 120%	--	20%
Volatile Suspended Solids	1 mg/L	80 – 120%	--	20%
Nitrate + Nitrite -Nitrogen	0.1 mg/L	80 – 120%	20%	20%
Total Kjeldahl Nitrogen (T&D)	0.1 mg/L	80 – 120%	20%	20%
Phosphorus (T&D)	0.03 mg/L	80 – 120%	20%	20%
Total Organic Carbon	1 mg/L	85 – 115%	15%	15%
Aluminum (T, D, & acid soluble)	25 µg/L	75 – 125%	20%	20%
Iron (T&D)	25 µg/L	75 – 125%	20%	20%

[a] RPD = Relative Percent Difference

Matrix Spike/Matrix Duplicates (MS/MSD)

Matrix spikes and duplicates are prepared in the laboratory by laboratory personnel. The laboratory prepares matrix spike samples by splitting off three sample aliquots and adding known amounts of the target analyte to two of the three environmental sample aliquots. The results of the un-spiked sample are then compared to the spiked (MS) analysis results, and "percent recovery" is calculated. The results of the MS/MSD analyses are compared to the calculated recoveries and specified relative percent difference (RPD, listed in Table A-4) specified in the project's Sample and Analysis Plan.

A sample result was qualified "U" (anomalous) if the result was outside the control limits. A "t" reason code was assigned for MS/MSD results outside specified limits.

Duplicates

Replicate samples for the assessment of precision were generated both in the field and the laboratory. The laboratory prepares duplicate samples by splitting one of the samples received. Field samples are prepared in the field by collecting a single sample and dividing it (splitting) into two separate containers (or bottle sets). Calculating the RPD assesses the precision of replicate samples.

Acceptable project precision for laboratory duplicates is presented in Table A-4. If the agreement between replicates exceeds the RPD values listed, the data were considered "estimated" and both results were issued the "J" qualifier. An "e" reason code was assigned for laboratory duplicates outside the specified RPD.

The acceptable RPD for field duplicates is 50 percent, as specified in the Caltrans Storm Water Monitoring Protocols Guidance Manual (Caltrans, 2000a). If the primary and duplicate results exceed this value, the data were considered "estimated" and both results issued the "J" qualifier. A "g" reason code was assigned for field duplicates imprecision.

Total/Dissolved Comparison

Laboratory results for constituents in which both total and dissolved measurements were made were evaluated for agreement.

If the dissolved sample result exceeds the total result by more than the reporting limit (or 10 percent), the data were considered "estimated" and both results were issued the "J" qualifier. If the dissolved sample result exceeds the total result by more than 2 times the reporting limit (or 20 percent), the data were "rejected" and both results were issued the "R" qualifier. The "c" reason code is used for qualified dissolved > total results.

Performance Evaluation Samples

Performance evaluation (PE) samples are commercially prepared samples containing certified levels of known constituents. PE samples were purchased and sent to the laboratory "blind", alongside routine project samples. Laboratory reports for these samples were reviewed with respect to the control limits.

DATA QUALIFIER AND REASON CODES

Data Qualifier Definitions

U The material was analyzed for, but was not detected above the level of the associated value (the associated value represents a reporting limit that may or may not be elevated due to blank contamination (CTSW-RT-01-057).

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample. The identification of the analyte is acceptable, but quality assurance criteria indicate that the quantitative values may be outside the normal expected range of precision, i.e., the quantitative value is considered estimated.

UJ This is a combination of the U and J flags. The analyte is not present. The reported value is considered to be an estimated contract required quantization limit (CRQL). The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample result is rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified. This flag denotes the failure of quality control criteria such that it can not be determined if the analyte is present or absent from the sample

Data Qualifier Reason Code Definitions

a Holding time violation

c Dissolved concentration significantly exceeded the total concentration

e Laboratory duplicate imprecision

g Field duplicate imprecision

i Method blank contamination

k Equipment blank contamination

m Bottle blank contamination

o Trip blank contamination

q Laboratory control sample recovery failure

t Matrix spike/matrix spike duplicate recovery failure

LABORATORY REPORT QC CHECKLIST (Phase IV)

Date Sampled ________________ PatChem ID Base Number ____________________

Date Lab Received ____________ ID Number Range ________________________

Date Reported ________________ ________________________

Analysis Requested/Received:

#	Parameter	#	Parameter	#	Parameter
	Acid-Al		Alk-T		Phos-T
	Al-T		Phos-D		TSS
	Fe-T		TKN		VSS
	Al-D		TKN-D		NO2+NO3
	Fe-D		TOC		

Were samples analyzed using the requested/required analytical method (Y/N) _______________

Were the results reported at the requested/required reporting limits (Y/N) __________________

Are there any holding time violations (list) ____

Parameter	Number of Acceptable Determinations*						
	Blank	LCS	LCS Dup	Dup	MS	MSD	SRM
Acid-Al							
Al-T							
Fe-T							
Al-D							
Fe-D							
Alk-T							
Phos-D							
TKN							
TKN-D							
Phos-T							
TSS							
VSS							
NO2+NO3							
TOC							

*Acceptance criteria based on DQO specified in the M&O Plan (statistic = hits, %R, RPD).

Table A-5. Phase IV Laboratory Sample Count and Qualifiers by Treatment System

Parameter	Column Effluents		12" and Interface		Jar Test Samples		Sed Exp. Samples		Project Totals		
(Lab)	Total	# Qualified	Total	# Qualified	Total	# Qualified	Total	# Qualified	# Determinations	# Qualified	% Qualified
Acid Soluble Aluminum	196	1							196	1	0.5
Aluminum - total	196	1							196	1	0.5
Aluminum - dissolved	196	0							196	0	0.0
Alkalinity - total	196	0							196	0	0.0
Phosphorus - dissolved	204	0	185	0	159	0	348	0	896	0	0.0
Kjeldahl Nitrogen - total	196	28							196	28	14.3
Kjeldahl Nitrogen - dissolved	196	28							196	28	14.3
Phosphorus - total	204	0	185	0	159	0	348	0	896	0	0.0
Total Suspended Solids	196	16							196	16	8.2
Nitrate + Nitrite	196	0							196	0	0.0
Total Nitrogen (calculated)	196	28							196	28	14.3
Iron - total	120	0							120	0	0.0
Iron - dissolved	120	0							120	0	0.0
Total Organic Carbon	16	1							16	1	6.3
Volatile Suspended Solids	8	1							8	1	12.5
								Total Number (Lab) =	3,820	104	2.7
Parameter	**Column Effluents**		**12" and Interface**		**Jar Test Samples**		**Sed Exp. Samples**		**Project Totals**		
(Field)	**Total**	**# Qualified**	**Total**	**# Qualified**	**Total**	**# Qualified**	**Total**	**# Qualified**	**# Determinations**	**# Qualified**	**% Qualified**
Turbidity	196	0	185	0	159	0	348	0	888	0	0.0
EC	196	0	185	0	159	0	28	0	568	0	0.0
pH	196	0	185	0	159	0	28	0	568	0	0.0
Temperature	196	0	185	0	159	0	28	0	568	0	0.0
								Total Number (Field) =	2,592	0	0.0
								Total (Lab and Field) =	6,412	104	1.6

Table A-6. Phase IV Laboratory Duplicate Samples by Treatment System

Parameter	Column Effluents		12" and Interface		Jar Test Samples		Sed Exp. Samples		Project Totals		
	# Dups	# Fail	# Dups	# Fail	# Dups	# Fail	# Dups	# Fail	# Duplicate Samples	# Fail	% Fail
Acid Soluble Aluminum	21	2							21	2	9.5
Aluminum - total	21	0							21	0	0.0
Aluminum - dissolved	21	3							21	3	14.3
Alkalinity - total	21	0							21	0	0.0
Phosphorus - dissolved	21	0	11	0	14	0	48	0	94	0	0.0
Kjeldahl Nitrogen - total	21	3							21	3	14.3
Kjeldahl Nitrogen - dissolved	21	5							21	5	23.8
Phosphorus - total	21	1	11	0	14	0	48	0	94	1	1.1
Total Suspended Solids	21	4							21	4	19.0
Nitrate + Nitrite	21	0							21	0	0.0
Total Nitrogen (calculated)	21	3							21	3	14.3
Iron - total	15	0							15	0	0.0
Iron - dissolved	15	3							15	3	20.0
Total Organic Carbon	2	1							2	1	50.0
Volatile Suspended Solids	0	0							0	0	
								Total Number =	409	25	6.1

Table A-7. Phase IV Equipment Blank Samples by Treatment System

Parameter	Column Effluents		12" and Interface		Jar Test Samples		Sed Exp. Samples		Project Totals		
	# Blks	# Hits	# Blks	# Hits	# Blks	# Hits	# Blks	# Hits	# Equipment Blanks	# Hits	% Hit
Acid Soluble Aluminum	14	0							14	0	0.0
Aluminum - total	14	0							14	0	0.0
Aluminum - dissolved	14	0							14	0	0.0
Alkalinity - total	14	0							14	0	0.0
Phosphorus - dissolved	14	0	14	0	15	0	24	0	67	0	0.0
Kjeldahl Nitrogen - total	14	1							14	1	7.1
Kjeldahl Nitrogen - dissolved	14	0							14	0	0.0
Phosphorus - total	14	1	14	0	15	1	24	2	67	4	6.0
Total Suspended Solids	14	1							14	1	7.1
Nitrate + Nitrite	14	0							14	0	0.0
Total Nitrogen (calculated)	14	0							14	0	0.0
Iron - total	7	1							7	1	14.3
Iron - dissolved	7	0							7	0	0.0
Total Organic Carbon	0	0							0	0	0.0
Volatile Suspended Solids	0	0							0	0	0.0
								Total Number =	274	7	2.6

Table A-8. Phase IV Bottle Blank Samples by Treatment System

Parameter	Column Effluents		12" and Interface		Jar Test Samples		Sed Exp. Samples		Project Totals		
	# Blks	# Hits	# Blks	# Hits	# Blks	# Hits	# Blks	# Hits	# Bottle Blanks	# Hits	% Hit
Acid Soluble Aluminum	14	0							14	0	0.0
Aluminum - total	14	0							14	0	0.0
Aluminum - dissolved	14	0							14	0	0.0
Alkalinity - total	14	1							14	1	7.1
Phosphorus - dissolved	14	0	13	0	15	0	12	0	54	0	0.0
Kjeldahl Nitrogen - total	14	2							14	2	14.3
Kjeldahl Nitrogen - dissolved	14	0							14	0	0.0
Phosphorus - total	14	2	13	0	15	2	12	1	54	5	9.3
Total Suspended Solids	14	2							14	2	14.3
Nitrate + Nitrite	14	0							14	0	0.0
Total Nitrogen (calculated)	14	0							14	0	0.0
Iron - total	7	0							7	0	0.0
Iron - dissolved	7	0							7	0	0.0
Total Organic Carbon	4	1							4	1	25.0
Volatile Suspended Solids	0	0							0	0	0.0
								Total Number =	252	11	4.4

Table A-9. Phase IV QC Qualifier and Reason Code Sample Count

Parameter	4-Inch Filter Column Samples			Jar Test Samples			Settling Experiment Samples		
	# Samples	# Qualified	Qual/Reason	# Samples	# Qualified	Qual/Reason	# Samples	# Qualified	Qual/Reason
pH (field)	381	0		159	0		348	0	
EC (field)	381	0		159	0		28	0	
Turbidity (field)	381	0		159	0		28	0	
Temperature (field)	381	0		159	0		28	0	
Alkalinity - total	196	0							
Acid Soluble Aluminum	196	1	R, c						
Aluminum - total	196	1	R, c						
Aluminum - dissolved	196	0							
Iron - dissolved	120	0							
Iron - total	120	0							
Phosphorus - dissolved	389	0		159	0		348	0	
Phosphorus - total	389	0		159	0		348	0	
Kjeldahl Nitrogen - dissolved	196	28	J, g						
Kjeldahl Nitrogen - total	196	28	J, g						
Nitrate + Nitrite	196	0							
Total Nitrogen (calculated)	196	28	J, g						
Total Organic Carbon	16	1	J, g						
Total Organic Carbon		2	U, m						
Total Suspended Solids	196	16	J, a						
Volatile Suspended Solids	8	1	J, a						

Appendix B

4-Inch Extended Run Filter Columns - Data

Table B-1. 4-Inch Filter Column Feed Flow Rate and Volume Filtered

COLUMN 1	**(Existing Activated Alumina)**								
Run Number	Avg. Flowrate (mL/min)	Avg. Flowrate (gpd)	Tot. Vol (L)	Tot Vol (gal)	Application (ft)	Application (m)	Application (% Annual)	Loading (Lpm/m2)	Loading (gpm/ft2)
18	20.5	7.8	233.5	61.7	94.5	28.8	105.0	2.53	0.062
19	20.8	7.9	108.7	28.7	44.0	13.4	48.9	2.56	0.063
20	20.7	7.9	145.6	38.5	58.9	18.0	65.5	2.55	0.062
21	20.3	7.7	176.8	46.7	71.6	21.8	79.5	2.51	0.061
22	20.7	7.8	207.5	54.8	84.0	25.6	93.3	2.55	0.062
23	20.3	7.7	203.3	53.7	82.3	25.1	91.4	2.50	0.061
24	20.7	7.9	144.5	38.2	58.5	17.8	65.0	2.55	0.062
Average	20.6	7.8	174.3	46.0	70.5	21.5	78.4	2.53	0.062
Total	-	-	1,220	322	494	150	549	-	-

COLUMN 2	**(Existing Activated Alumina)**								
Run Number	Avg. Flowrate (mL/min)	Avg. Flowrate (gpd)	Tot. Vol (L)	Tot Vol (gal)	Application (ft)	Application (m)	Application (% Annual)	Loading (Lpm/m2)	Loading (gpm/ft2)
18	20.8	7.9	237.6	62.8	96.2	29.3	106.8	2.57	0.063
19	20.3	7.7	119.7	31.6	48.4	14.8	53.8	2.50	0.061
20	20.5	7.8	160.3	42.4	64.9	19.8	72.1	2.53	0.062
21	20.3	7.7	172.0	45.4	69.6	21.2	77.3	2.51	0.062
22	20.2	7.7	203.3	53.7	82.3	25.1	91.4	2.50	0.061
23	20.1	7.6	201.2	53.2	81.4	24.8	90.5	2.48	0.061
24	20.4	7.7	159.2	42.1	64.4	19.6	71.6	2.51	0.062
Average	20.4	7.7	179.0	47.3	72.5	22.1	80.5	2.52	0.062
Total	-	-	1,253	331	507	155	564	-	-

COLUMN 3	**(Existing F-105 Filter Sand)**								
Run Number	Avg. Flowrate (mL/min)	Avg. Flowrate (gpd)	Tot. Vol (L)	Tot Vol (gal)	Application (ft)	Application (m)	Application (% Annual)	Loading (Lpm/m2)	Loading (gpm/ft2)
18	20.4	7.7	233.5	61.7	94.5	28.8	105.0	2.51	0.062
19	20.4	7.7	104.6	27.6	42.3	12.9	47.0	2.51	0.062
20	20.2	7.7	175.0	46.2	70.8	21.6	78.7	2.49	0.061
21	20.3	7.7	175.3	46.3	70.9	21.6	78.8	2.51	0.062
22	20.3	7.7	204.3	54.0	82.7	25.2	91.9	2.51	0.061
23	20.4	7.7	205.4	54.3	83.1	25.3	92.4	2.51	0.062
24	20.4	7.8	205.6	54.3	83.2	25.4	92.5	2.52	0.062
Average	20.3	7.7	186.2	49.2	75.4	23.0	83.8	2.51	0.061
Total	-	-	1,304	344	528	161	586	-	-

COLUMN 4	**(Existing F-105 Filter Sand)**								
Run Number	Avg. Flowrate (mL/min)	Avg. Flowrate (gpd)	Tot. Vol (L)	Tot Vol (gal)	Application (ft)	Application (m)	Application (% Annual)	Loading (Lpm/m2)	Loading (gpm/ft2)
18	19.8	7.5	225.6	59.6	91.3	27.8	101.5	2.44	0.060
19	21.2	8.1	121.6	32.1	49.2	15.0	54.7	2.62	0.064
20	20.4	7.7	176.6	46.7	71.5	21.8	79.4	2.51	0.062
21	20.3	7.7	172.5	45.6	69.8	21.3	77.6	2.50	0.061
22	20.5	7.8	207.4	54.8	83.9	25.6	93.3	2.53	0.062
23	20.2	7.7	203.3	53.7	82.3	25.1	91.4	2.49	0.061
24	20.4	7.8	205.7	54.3	83.3	25.4	92.5	2.52	0.062
Average	20.4	7.7	187.5	49.5	75.9	23.1	84.3	2.52	0.062
Total	-	-	1,313	347	531	162	590	-	-

Table B-1. 4-Inch Filter Column Feed Flow Rate and Volume Filtered, Continued

COLUMN 5	**(New 28x48 Mesh AA)**								
Run Number	Avg. Flowrate (mL/min)	Avg. Flowrate (gpd)	Tot. Vol (L)	Tot Vol (gal)	Application (ft)	Application (m)	Application (% Annual)	Loading (Lpm/m2)	Loading (gpm/ft2)
18	20.3	7.7	234.1	61.8	94.7	28.9	105.3	2.51	0.061
19	20.9	8.0	122.5	32.4	49.6	15.1	55.1	2.58	0.063
20	20.1	7.7	171.1	45.2	69.2	21.1	76.9	2.48	0.061
21	20.1	7.6	173.6	45.9	70.3	21.4	78.1	2.47	0.061
22	20.4	7.7	204.7	54.1	82.8	25.3	92.1	2.51	0.062
23	20.3	7.7	204.4	54.0	82.7	25.2	91.9	2.50	0.061
24	20.4	7.8	152.7	40.3	61.8	18.8	68.7	2.52	0.062
Average	20.4	7.7	180.4	47.7	73.0	22.3	81.1	2.51	0.062
Total	-	-	1,263	334	511	156	568	-	-

COLUMN 6	**(New 28x48 Mesh AA)**								
Run Number	Avg. Flowrate (mL/min)	Avg. Flowrate (gpd)	Tot. Vol (L)	Tot Vol (gal)	Application (ft)	Application (m)	Application (% Annual)	Loading (Lpm/m2)	Loading (gpm/ft2)
18	20.6	7.8	237.8	62.8	96.2	29.3	106.9	2.55	0.062
19	21.3	8.1	112.2	29.6	45.4	13.8	50.5	2.63	0.065
20	20.2	7.7	174.8	46.2	70.7	21.6	78.6	2.49	0.061
21	19.9	7.6	170.6	45.1	69.0	21.0	76.7	2.46	0.060
22	20.5	7.8	206.7	54.6	83.7	25.5	93.0	2.53	0.062
23	20.2	7.7	204.1	53.9	82.6	25.2	91.8	2.50	0.061
24	20.3	7.7	155.1	41.0	62.8	19.1	69.7	2.51	0.061
Average	20.5	7.8	180.2	47.6	72.9	22.2	81.0	2.52	0.062
Total	-	-	1,261	333	510	156	567	-	-

COLUMN 7	**(New 14x28 Mesh AA)**								
Run Number	Avg. Flowrate (mL/min)	Avg. Flowrate (gpd)	Tot. Vol (L)	Tot Vol (gal)	Application (ft)	Application (m)	Application (% Annual)	Loading (Lpm/m2)	Loading (gpm/ft2)
18	20.5	7.8	236.5	62.5	95.7	29.2	106.4	2.53	0.062
19	20.9	7.9	122.1	32.3	49.4	15.1	54.9	2.57	0.063
20	20.3	7.7	176.5	46.6	71.4	21.8	79.4	2.51	0.061
21	20.3	7.7	171.1	45.2	69.2	21.1	76.9	2.50	0.061
22	20.4	7.8	206.3	54.5	83.5	25.4	92.8	2.52	0.062
23	20.3	7.7	203.7	53.8	82.4	25.1	91.6	2.50	0.061
24	20.3	7.7	181.4	47.9	73.4	22.4	81.6	2.51	0.061
Average	20.4	7.8	185.4	49.0	75.0	22.9	83.4	2.52	0.062
Total	-	-	1,298	343	525	160	584	-	-

COLUMN 8	**(New 14x28 Mesh AA)**								
Run Number	Avg. Flowrate (mL/min)	Avg. Flowrate (gpd)	Tot. Vol (L)	Tot Vol (gal)	Application (ft)	Application (m)	Application (% Annual)	Loading (Lpm/m2)	Loading (gpm/ft2)
18	20.2	7.7	232.6	61.5	94.1	28.7	104.6	2.49	0.061
19	20.8	7.9	120.0	31.7	48.6	14.8	54.0	2.56	0.063
20	20.3	7.7	175.9	46.5	71.2	21.7	79.1	2.50	0.061
21	20.2	7.7	175.1	46.3	70.9	21.6	78.7	2.49	0.061
22	20.7	7.9	209.8	55.4	84.9	25.9	94.3	2.56	0.063
23	20.6	7.8	206.9	54.7	83.7	25.5	93.0	2.54	0.062
24	20.1	7.6	202.8	53.6	82.1	25.0	91.2	2.48	0.061
Average	20.4	7.8	189.0	49.9	76.5	23.3	85.0	2.52	0.062
Total	-	-	1,323	350	535	163	595	-	-

Table B-1. 4-Inch Filter Column Feed Flow Rate and Volume Filtered, Continued

COLUMN 9	**(Superior 30 Sand)**								
Run Number	Avg. Flowrate (mL/min)	Avg. Flowrate (gpd)	Tot. Vol (L)	Tot Vol (gal)	Application (ft)	Application (m)	Application (% Annual)	Loading (Lpm/m2)	Loading (gpm/ft2)
18	20.6	7.8	235.8	62.3	95.4	29.1	106.0	2.54	0.062
19	20.6	7.8	120.6	31.9	48.8	14.9	54.2	2.55	0.062
20	20.2	7.7	169.7	44.8	68.7	20.9	76.3	2.49	0.061
21	20.3	7.7	177.1	46.8	71.7	21.8	79.6	2.51	0.061
22	20.9	7.9	210.7	55.7	85.3	26.0	94.8	2.58	0.063
23	20.2	7.7	204.0	53.9	82.6	25.2	91.7	2.50	0.061
24	20.2	7.7	203.7	53.8	82.4	25.1	91.6	2.49	0.061
Average	20.4	7.8	188.8	49.9	76.4	23.3	84.9	2.52	0.062
Total	-	-	1,322	349	535	163	594	-	-

COLUMN 10	**(Superior 30 Sand)**								
Run Number	Avg. Flowrate (mL/min)	Avg. Flowrate (gpd)	Tot. Vol (L)	Tot Vol (gal)	Application (ft)	Application (m)	Application (% Annual)	Loading (Lpm/m2)	Loading (gpm/ft2)
18	20.1	7.7	230.8	61.0	93.4	28.5	103.8	2.49	0.061
19	20.9	7.9	122.2	32.3	49.5	15.1	55.0	2.58	0.063
20	20.4	7.8	173.6	45.9	70.3	21.4	78.1	2.52	0.062
21	20.8	7.9	180.4	47.7	73.0	22.3	81.1	2.57	0.063
22	20.6	7.8	207.9	54.9	84.1	25.6	93.5	2.54	0.062
23	20.1	7.6	202.5	53.5	82.0	25.0	91.1	2.48	0.061
24	20.3	7.7	204.3	54.0	82.7	25.2	91.9	2.50	0.061
Average	20.5	7.8	188.8	49.9	76.4	23.3	84.9	2.53	0.062
Total	-	-	1,322	349	535	163	594	-	-

COLUMN 11	**(Limestone)**								
Run Number	Avg. Flowrate (mL/min)	Avg. Flowrate (gpd)	Tot. Vol (L)	Tot Vol (gal)	Application (ft)	Application (m)	Application (% Annual)	Loading (Lpm/m2)	Loading (gpm/ft2)
18	20.5	7.8	235.8	62.3	95.4	29.1	106.0	2.52	0.062
19	20.4	7.8	119.4	31.5	48.3	14.7	53.7	2.52	0.062
20	20.5	7.8	177.8	47.0	72.0	21.9	80.0	2.53	0.062
21	20.2	7.7	174.9	46.2	70.8	21.6	78.7	2.49	0.061
22	20.8	7.9	209.6	55.4	84.8	25.9	94.3	2.57	0.063
23	20.4	7.8	205.6	54.3	83.2	25.4	92.5	2.52	0.062
24	20.5	7.8	206.5	54.6	83.6	25.5	92.9	2.53	0.062
Average	20.5	7.8	189.9	50.2	76.9	23.4	85.4	2.53	0.062
Total	-	-	1,330	351	538	164	598	-	-

COLUMN 12	**(Limestone)**								
Run Number	Avg. Flowrate (mL/min)	Avg. Flowrate (gpd)	Tot. Vol (L)	Tot Vol (gal)	Application (ft)	Application (m)	Application (% Annual)	Loading (Lpm/m2)	Loading (gpm/ft2)
18	20.6	7.8	233.0	61.6	94.3	28.7	104.8	2.54	0.062
19	21.0	8.0	122.9	32.5	49.7	15.2	55.3	2.59	0.064
20	20.1	7.6	173.9	45.9	70.4	21.5	78.2	2.48	0.061
21	20.8	7.9	179.5	47.4	72.6	22.1	80.7	2.56	0.063
22	20.6	7.8	207.3	54.8	83.9	25.6	93.2	2.54	0.062
23	20.3	7.7	204.9	54.1	82.9	25.3	92.1	2.51	0.061
24	20.8	7.9	209.2	55.3	84.7	25.8	94.1	2.56	0.063
Average	20.6	7.8	190.1	50.2	76.9	23.5	85.5	2.54	0.062
Total	-	-	1,331	352	539	164	598	-	-

Table B-1. 4-Inch Filter Column Feed Flow Rate and Volume Filtered, Continued

COLUMN 13	**(Fe-Modified AA)**								
Run Number	Avg. Flowrate (mL/min)	Avg. Flowrate (gpd)	Tot. Vol (L)	Tot Vol (gal)	Application (ft)	Application (m)	Application (% Annual)	Loading (Lpm/m2)	Loading (gpm/ft2)
18	20.3	7.7	233.3	61.6	94.4	28.8	104.9	2.50	0.061
19	21.0	8.0	104.5	27.6	42.3	12.9	47.0	2.59	0.063
20	19.9	7.6	157.8	41.7	63.9	19.5	71.0	2.46	0.060
21	20.8	7.9	148.7	39.3	60.2	18.3	66.9	2.57	0.063
22	20.8	7.9	112.3	29.7	45.5	13.9	50.5	2.56	0.063
23	20.5	7.8	207.0	54.7	83.8	25.5	93.1	2.53	0.062
24	20.5	7.8	206.9	54.7	83.7	25.5	93.0	2.53	0.062
Average	20.5	7.8	167.2	44.2	67.7	20.6	75.2	2.53	0.062
Total	-	-	1,171	309	474	144	526	-	-

COLUMN 14	**(Fe-Modified AA)**								
Run Number	Avg. Flowrate (mL/min)	Avg. Flowrate (gpd)	Tot. Vol (L)	Tot Vol (gal)	Application (ft)	Application (m)	Application (% Annual)	Loading (Lpm/m2)	Loading (gpm/ft2)
18	20.4	7.8	234.3	61.9	94.8	28.9	105.4	2.52	0.062
19	21.1	8.0	123.3	32.6	49.9	15.2	55.4	2.60	0.064
20	20.1	7.7	162.4	42.9	65.7	20.0	73.0	2.48	0.061
21	20.6	7.8	134.9	35.6	54.6	16.6	60.7	2.54	0.062
22	20.3	7.7	99.3	26.2	40.2	12.2	44.7	2.50	0.061
23	20.4	7.8	205.7	54.3	83.3	25.4	92.5	2.52	0.062
24	20.5	7.8	207.1	54.7	83.8	25.5	93.1	2.53	0.062
Average	20.5	7.8	166.7	44.0	67.5	20.6	75.0	2.53	0.062
Total	-	-	1,167	308	472	144	525	-	-

COLUMN 15	**(GFH)**								
Run Number	Avg. Flowrate (mL/min)	Avg. Flowrate (gpd)	Tot. Vol (L)	Tot Vol (gal)	Application (ft)	Application (m)	Application (% Annual)	Loading (Lpm/m2)	Loading (gpm/ft2)
18	20.8	7.9	233.7	61.7	94.6	28.8	105.1	2.57	0.063
19	21.1	8.0	116.9	30.9	47.3	14.4	52.6	2.60	0.064
20	20.2	7.7	175.2	46.3	70.9	21.6	78.8	2.49	0.061
21	20.6	7.8	162.9	43.0	65.9	20.1	73.3	2.54	0.062
22	20.1	7.6	200.9	53.1	81.3	24.8	90.3	2.47	0.061
23	20.6	7.8	207.4	54.8	83.9	25.6	93.3	2.54	0.062
24	20.3	7.7	132.1	34.9	53.5	16.3	59.4	2.51	0.061
Average	20.5	7.8	175.6	46.4	71.1	21.7	79.0	2.53	0.062
Total	-	-	1,229	325	497	152	553	-	-

COLUMN 16	**(GFH)**								
Run Number	Avg. Flowrate (mL/min)	Avg. Flowrate (gpd)	Tot. Vol (L)	Tot Vol (gal)	Application (ft)	Application (m)	Application (% Annual)	Loading (Lpm/m2)	Loading (gpm/ft2)
18	20.6	7.8	230.7	61.0	93.4	28.5	103.7	2.54	0.062
19	20.8	7.9	120.6	31.9	48.8	14.9	54.2	2.56	0.063
20	20.1	7.6	174.3	46.1	70.5	21.5	78.4	2.48	0.061
21	20.3	7.7	173.1	45.7	70.1	21.4	77.8	2.51	0.062
22	20.2	7.7	201.9	53.3	81.7	24.9	90.8	2.50	0.061
23	20.3	7.7	205.0	54.2	83.0	25.3	92.2	2.51	0.062
24	20.6	7.8	145.5	38.4	58.9	17.9	65.4	2.54	0.062
Average	20.4	7.8	178.7	47.2	72.3	22.0	80.4	2.52	0.062
Total	-	-	1,251	331	506	154	563	-	-

Table B-1. 4-Inch Filter Column Feed Flow Rate and Volume Filtered, Continued

COLUMN 17	**(Bayoxide E-33)**								
Run Number	Avg. Flowrate (mL/min)	Avg. Flowrate (gpd)	Tot. Vol (L)	Tot Vol (gal)	Application (ft)	Application (m)	Application (% Annual)	Loading (Lpm/m2)	Loading (gpm/ft2)
18	20.5	7.8	236.6	62.5	95.8	29.2	106.4	2.53	0.062
19	20.8	7.9	109.0	28.8	44.1	13.4	49.0	2.56	0.063
20	19.6	7.4	169.9	44.9	68.8	21.0	76.4	2.42	0.059
21	20.6	7.8	173.2	45.8	70.1	21.4	77.9	2.54	0.062
22	20.2	7.7	204.5	54.0	82.8	25.2	92.0	2.50	0.061
23	20.5	7.8	205.5	54.3	83.2	25.4	92.4	2.53	0.062
24	20.3	7.7	159.1	42.0	64.4	19.6	71.5	2.51	0.061
Average	20.4	7.7	179.7	47.5	72.7	22.2	80.8	2.51	0.062
Total	-	-	1,258	332	509	155	566	-	-

COLUMN 18	**(Bayoxide E-33)**								
Run Number	Avg. Flowrate (mL/min)	Avg. Flowrate (gpd)	Tot. Vol (L)	Tot Vol (gal)	Application (ft)	Application (m)	Application (% Annual)	Loading (Lpm/m2)	Loading (gpm/ft2)
18	20.6	7.8	230.0	60.8	93.1	28.4	103.4	2.54	0.062
19	20.7	7.9	121.1	32.0	49.0	14.9	54.5	2.55	0.063
20	20.1	7.6	174.4	46.1	70.6	21.5	78.4	2.48	0.061
21	20.4	7.7	175.8	46.4	71.2	21.7	79.1	2.52	0.062
22	20.7	7.9	200.0	52.8	80.9	24.7	89.9	2.56	0.063
23	20.6	7.8	207.9	54.9	84.1	25.6	93.5	2.54	0.062
24	20.6	7.8	197.3	52.1	79.9	24.3	88.7	2.54	0.062
Average	20.5	7.8	186.6	49.3	75.5	23.0	83.9	2.53	0.062
Total	-	-	1,307	345	529	161	588	-	-

Table B-2. 4-Inch Scale Filter Column Loading Calculations, Column 1, Existing Activated Alumina (28/48)

(Existing AA)			Column Status and Filtration Volumes								Average Clarifier Concentration				Calculated Load				Calculated Load at Failure/Activity					"Typical" Tahoe Storm Water Concentrations					Calculated "Typical" Tahoe Load				Calculated "Tahoe" Load at Failure/Activity				Percent of "Typical" Tahoe Storm Water Treated				
Col	Run #	Run Day	Status/Activity	Time	Hours In-Service (hrs)	Average Flowrate (ml/min)	Calc Vol. Filtered (L)	Overflow Adjust (L)	**Volume Filtered (L)**	**Feet Filtered (ft)**	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Total Filter Load (ft)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (ft)	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (% of annual)	Turb (%)	TSS (%)	Tot-P (%)	Dis-P (%)
1	18	0	Column Start-up	8:20	0	0.0	0.0		0.0	0.0	106	44	0.10	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
1	18	1	Running	8:20	24	20.3	29.2		29.2	11.8	106	44	0.10	0.015	1,254	1,286	2.92	0.44						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
1	18	2	Running	8:20	24	20.7	29.8		29.8	12.1	106	44	0.10	0.015	1,279	1,312	2.98	0.45						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
1	18	3	Running	8:20	24	20.6	29.7		29.7	12.0	106	44	0.10	0.015	1,273	1,305	2.97	0.44						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
1	18	4	Running	8:20	24	19.9	28.7		28.7	11.6	106	44	0.10	0.015	1,230	1,261	2.87	0.43						90	477	759	2.14	0.07	5,534	21,750	61.32	2.01									
1	18	5	In Failure	8:20	24	20.1	28.9	0.2	28.7	11.6	106	44	0.10	0.015	1,233	1,264	2.87	0.43						90	477	759	2.14	0.07	5,549	21,809	61.49	2.01									
1	18	5	Sand Cap Replaced	10:00-12:00	0	20.1	0.0		0.0	0.0	106	44	0.10	0.015	0	0	0.00	0.00	59	6,270	6,428	14.61	2.19	90	477	759	2.14	0.07	0	0	0.00	0.00	28,213	110,885	312.64	10.23	65.7	22.2	5.8	4.7	21.4
1	18	6	Running	8:20	22	21.1	27.9		27.9	11.3	106	44	0.10	0.015	1,195	1,225	2.79	0.42						90	477	759	2.14	0.07	5,379	21,140	59.60	1.95									
1	18	7	Running	8:20	24	20.4	29.4		29.4	11.9	106	44	0.10	0.015	1,261	1,293	2.94	0.44						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
1	18	8	Running/end run	8:15	24	20.9	30.1		30.1	12.2	106	44	0.10	0.015	1,292	1,324	3.01	0.45						90	477	759	2.14	0.07	5,812	22,843	64.41	2.11									
1	19	0	Column Start-up	12:00	0	0.0	0.0		0.0	0.0	591	272	0.24	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
1	19	1	In Failure	8:30	20.5	20.6	25.3	9.5	15.8	6.4	591	272	0.24	0.015	3,790	4,308	3.80	0.24						90	477	759	2.14	0.07	3,059	12,021	33.89	1.11									
1	19	1	Sand Cap Replaced	8:30-11:00	0	20.6	0.0		0.0	0.0	591	272	0.24	0.015	0	0	0.00	0.00	42	7,537	8,150	12.53	1.55	90	477	759	2.14	0.07	0	0	0.00	0.00	19,922	78,300	220.77	7.22	46.4	37.8	10.4	5.7	21.4
1	19	1	Running	12:00	1	20.6	1.2		1.2	0.5	591	272	0.24	0.015	296	336	0.30	0.02						90	477	759	2.14	0.07	239	938	2.65	0.09									
1	19	2	Running	12:00	24	20.5	29.5		29.5	12.0	591	272	0.24	0.015	7,063	8,029	7.08	0.44						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
1	19	3	Running	12:00	24	20.9	30.1		30.1	12.2	591	272	0.24	0.015	7,201	8,186	7.22	0.45						90	477	759	2.14	0.07	5,812	22,843	64.41	2.11									
1	19	4	Running/end run	13:30	25.5	21.0	32.1		32.1	13.0	591	272	0.24	0.015	7,688	8,739	7.71	0.48						90	477	759	2.14	0.07	6,205	24,387	68.76	2.25									
1	20	0	Column Start-up	8:30	0	0.0	0.0		0.0	0.0	627	280	0.58	0.04	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
1	20	1	In Failure	8:30	24	20.9	30.1	13.2	16.9	6.8	627	280	0.58	0.04	4,279	4,720	9.78	0.67						90	477	759	2.14	0.07	3,255	12,794	36.07	1.18									
1	20	1	2" Media Replaced	15:30-16:45	0	20.9	0.0		0.0	0.0	627	280	0.58	0.04	0	0	0.00	0.00	44	26,527	30,011	32.09	2.07	90	477	759	2.14	0.07	0	0	0.00	0.00	21,212	83,367	235.05	7.69	49.4	125.1	36.0	13.7	26.9
1	20	2	In Failure	8:30	22.75	20.1	27.4	3.8	23.6	9.6	627	280	0.58	0.04	6,000	6,618	13.71	0.95						90	477	759	2.14	0.07	4,565	17,940	50.58	1.65									
1	20	3	In Failure	8:30	24	20.6	29.7	13.9	15.8	6.4	627	280	0.58	0.04	4,002	4,414	9.14	0.63						90	477	759	2.14	0.07	3,044	11,965	33.73	1.10									
1	20	3	6" Media Replaced	11:30-12:30	0	20.6	0.0		0.0	0.0	627	280	0.58	0.04	0	0	0.00	0.00	16	10,002	11,032	22.85	1.58	90	477	759	2.14	0.07	0	0	0.00	0.00	7,609	29,905	84.32	2.76	17.7	131.4	36.9	27.1	57.1
1	20	4	Running	8:30	23	20.8	28.7		28.7	11.6	627	280	0.58	0.04	7,286	8,037	16.65	1.15						90	477	759	2.14	0.07	5,543	21,786	61.43	2.01									
1	20	5	Running	8:30	24	20.8	30.0		30.0	12.1	627	280	0.58	0.04	7,603	8,387	17.37	1.20						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
1	20	6	Running/end run	9:00	24.5	20.8	30.6		30.6	12.4	627	280	0.58	0.04	7,762	8,561	17.73	1.22						90	477	759	2.14	0.07	5,905	23,207	65.43	2.14									
1	21	0	Column Start-up	9:00	0	0.0	0.0		0.0	0.0	156	85	0.30	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
1	21	1	Running	9:00	24	20.6	29.7		29.7	12.0	156	85	0.30	0.015	1,874	2,521	8.90	0.44						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
1	21	2	Running	9:00	24	19.9	28.7		28.7	11.6	156	85	0.30	0.015	1,810	2,436	8.60	0.43						90	477	759	2.14	0.07	5,534	21,750	61.32	2.01									
1	21	3	Running	9:00	24	20.0	28.8		28.8	11.7	156	85	0.30	0.015	1,819	2,448	8.64	0.43						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
1	21	4	Running	9:00	24	19.8	28.5		28.5	11.5	156	85	0.30	0.015	1,801	2,424	8.55	0.43						90	477	759	2.14	0.07	5,506	21,641	61.02	2.00									
1	21	5	Running	9:00	24	20.8	30.0		30.0	12.1	156	85	0.30	0.015	1,892	2,546	8.99	0.45						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
1	21	6	Running/end run	10:00	25	20.7	31.1		31.1	12.6	156	85	0.30	0.015	1,961	2,639	9.32	0.47						90	477	759	2.14	0.07	5,996	23,567	66.45	2.17									
1	22	0	Column Start-up	8:00	0	0.0	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
1	22	1	Running	8:00	24	20.7	29.8		29.8	12.1	266	134	0.32	0.14	3,210	3,994	9.54	4.17						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
1	22	2	Running	8:00	24	21.0	30.2		30.2	12.2	266	134	0.32	0.14	3,257	4,052	9.68	4.23						90	477	759	2.14	0.07	5,840	22,952	64.71	2.12									
1	22	3	In Failure	8:00	24	21.0	30.2		30.2	12.2	266	134	0.32	0.14	3,257	4,052	9.68	4.23						90	477	759	2.14	0.07	5,840	22,952	64.71	2.12									
1	22	3	Sand Cap Replaced	11:00-12:00	0	21.0	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00	144	43,530	52,097	133.64	18.86	90	477	759	2.14	0.07	0	0	0.00	0.00	68,780	270,321	762.17	24.93	160.2	63.3	19.3	17.5	75.6
1	22	4	Running	8:00	23	20.9	28.8		28.8	11.7	266	134	0.32	0.14	3,106	3,865	9.23	4.04						90	477	759	2.14	0.07	5,570	21,891	61.72	2.02									
1	22	5	Running	8:00	24	20.6	29.7		29.7	12.0	266	134	0.32	0.14	3,195	3,975	9.49	4.15						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
1	22	6	Running	8:00	24	20.4	29.4		29.4	11.9	266	134	0.32	0.14	3,164	3,936	9.40	4.11						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
1	22	7	Running/end run	8:30	24.5	20.0	29.4		29.4	11.9	266	134	0.32	0.14	3,166	3,940	9.41	4.12						90	477	759	2.14	0.07	5,678	22,315	62.92	2.06									
1	23	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	198	128	0.34	0.28	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
1	23	1	Running	10:00	24	20.6	29.7		29.7	12.0	198	128	0.34	0.28	2,378	3,797	10.09	8.31						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
1	23	2	Running	10:00	24	20.4	29.4		29.4	11.9	198	128	0.34	0.28	2,355	3,760	9.99	8.23						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
1	23	3	Running	10:00	24	20.2	29.1		29.1	11.8	198	128	0.34	0.28	2,332	3,723	9.89	8.14						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
1	23	4	Running	10:00	24	20.0	28.8		28.8	11.7	198	128	0.34	0.28	2,309	3,686	9.79	8.06						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
1	23	5	Running	10:00	24	20.1	28.9		28.9	11.7	198	128	0.34	0.28	2,320	3,705	9.84	8.10						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
1	23	6	Running	10:00	24	20.2	29.1		29.1	11.8	198	128	0.34	0.28	2,332	3,723	9.89	8.14						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
1	23	7	In Failure	10:00	24	20.3	29.2	1.0	28.3	11.5	198	128	0.34	0.28	2,267	3,620	9.62	7.92						90	477	759	2.14	0.07	5,462	21,466	60.52	1.98									
1	24	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
1	24	1	In Failure	10:00	24	20.9	30.1	15.1	15.0	6.1	330	162	0.55	0.32	1,998	2,423	8.23	4.79						90	477	759	2.14	0.07	2,888	11,352	32.01	1.05									
1	24	1	Sand Cap Replaced	13:15-13:45	0	20.9	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00	136	30,921	44,154	114.86	78.11	90	477	759	2.14	0.07	0	0	0.00	0.00	64,787	254,629	717.93	23.48	150.9	47.7	17.3	16.0	332.6
1	24	2	In Failure	9:00	22.5	20.4	27.5	11.4	16.2	6.6	330	162	0.55	0.32	2,162	2,621	8.90	5.18						90	477	759	2.14	0.07	3,125	12,281	34.63	1.13									
1	24	2	1" Media Replaced	9:15-9:45	0	20.4	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00	7	2,162	2,621	8.90	5.18	90	477	759	2.14	0.07	0	0	0.00	0.00	3,125	12,281	34.63	1.13	7.3	69.2	21.3	25.7	457.1
1	24	3	In Failure	10:00	24.5	20.3	29.8	15.9	13.9	5.6	330	162	0.55	0.32	1,863	2,258	7.67	4.46						90	477	759	2.14	0.07	2,692	10,581	29.83	0.98									
1	24	4	In Failure	10:00	24	20.5	29.5	18.9	10.6	4.3	330	162	0.55	0.32	1,415	1,716	5.82	3.39						90	477	759	2.14	0.07	2,045	8,038	22.66	0.74									
1	24	4	6" Media Replaced	10:30-11:30	0	20.5	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00	10	3,277	3,974	13.49	7.85	90	477	759	2.14	0.07	0	0	0.00	0.00	4,737	18,619	52.50	1.72	11.0	69.2	21.3	25.7	457.1
1	24	5	Running	10:00	23	20.6	28.4		28.4	11.5	330	162	0.55	0.32	3,798	4,605	15.64	9.10						90	477	759	2.14	0.07	5,490	21,577	60.84	1.99									
1	24	6	Running	10:00	24	21.0	30.2		30.2	12.2	330	162	0.55	0.32	4,040	4,899	16.63	9.68						90	477	759	2.14	0.07	5,840	22,952	64.71	2.12									
1	24	7	Running/end run	10:00	24	21.0	30.2		30.2	12.2	330	162	0.55	0.32	4,040	4,899	16.63	9.68	36	11,878	14,403	48.90	28.45	90	477	759	2.14	0.07	5,840	22,952	64.71	2.12	17,170	67,481	190.26	6.22					
								Sum =	1,220	494			Project totals =		142,104	172,871	402	146	494	142,104	172,871	402	146						235,554	925,788	2,610	85.4	235,554	925,788	2610	85.4					

Table B-3. 4-Inch Scale Filter Column Loading Calculations, Column 2, Existing Activated Alumina (28/48)

(Existing AA)

Column Status and Filtration Volumes											Average Clarifier Concentration				Calculated Load				Calculated Load at Failure/Activity					"Typical" Tahoe Storm Water Concentrations					Calculated "Typical" Tahoe Load				Calculated "Tahoe" Load at Failure/Activity				Percent of "Typical" Tahoe Storm Water Treated				
Col	Run #	Run Day	Status/Activity	Time	Hours In-Service (hrs)	Average Flowrate (ml/min)	Calc Vol. Filtered (L)	Overflow Adjust (L)	**Volume Filtered (L)**	**Feet Filtered (ft)**	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Total Filter Load (ft)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (ft)	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (% of annual)	Turb (%)	TSS (%)	Tot-P (%)	Dis-P (%)
2	18	0	Column Start-up	8:20	0	0.0	0.0		0.0	0.0	106	44	0.10	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
2	18	1	Running	8:20	24	20.4	29.4		29.4	11.9	106	44	0.10	0.015	1,261	1,293	2.94	0.44						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
2	18	2	Running	8:20	24	21.3	30.7		30.7	12.4	106	44	0.10	0.015	1,316	1,350	3.07	0.46						90	477	759	2.14	0.07	5,923	23,280	65.64	2.15									
2	18	3	Running	8:20	24	21.5	31.0		31.0	12.5	106	44	0.10	0.015	1,329	1,362	3.10	0.46						90	477	759	2.14	0.07	5,979	23,499	66.25	2.17									
2	18	4	Running	8:20	24	20.3	29.2		29.2	11.8	106	44	0.10	0.015	1,254	1,286	2.92	0.44						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
2	18	5	In Failure	8:20	24	20.7	29.8	1.2	28.6	11.6	106	44	0.10	0.015	1,228	1,259	2.86	0.43						90	477	759	2.14	0.07	5,525	21,713	61.22	2.00									
2	18	5	Sand Cap Replaced	10:00-12:00	0	20.7	0.0		0.0	0.0	106	44	0.10	0.015	0	0	0.00	0.00	60	6,388	6,549	14.88	2.23	90	477	759	2.14	0.07	0	0	0.00	0.00	28,745	112,976	318.53	10.42	67.0	22.2	5.8	4.7	21.4
2	18	6	Running	8:20	22	20.9	27.6		27.6	11.2	106	44	0.10	0.015	1,184	1,214	2.76	0.41						90	477	759	2.14	0.07	5,328	20,939	59.04	1.93									
2	18	7	Running	8:20	24	20.9	30.1		30.1	12.2	106	44	0.10	0.015	1,292	1,324	3.01	0.45						90	477	759	2.14	0.07	5,812	22,843	64.41	2.11									
2	18	8	Running/end run	8:15	24	20.7	29.8		29.8	12.1	106	44	0.10	0.015	1,279	1,312	2.98	0.45						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
2	19	0	Column Start-up	12:00	0	0.0	0.0		0.0	0.0	591	272	0.24	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
2	19	1	In Failure	8:30	20.5	20.2	24.8		24.8	10.1	591	272	0.24	0.015	5,945	6,758	5.96	0.37						90	477	759	2.14	0.07	4,798	18,858	53.17	1.74									
2	19	1	Sand Cap Replaced	8:30-11:00	0	20.2	0.0		0.0	0.0	591	272	0.24	0.015	0	0	0.00	0.00	45	9,700	10,608	14.71	1.69	90	477	759	2.14	0.07	0	0	0.00	0.00	21,694	85,265	240.40	7.86	50.5	44.7	12.4	6.1	21.4
2	19	1	Running	12:00	1	20.2	1.2		1.2	0.5	591	272	0.24	0.015	290	330	0.29	0.02						90	477	759	2.14	0.07	234	920	2.59	0.08									
2	19	2	Running	12:00	24	20.0	28.8		28.8	11.7	591	272	0.24	0.015	6,891	7,834	6.91	0.43						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
2	19	3	Running	12:00	24	20.4	29.4		29.4	11.9	591	272	0.24	0.015	7,029	7,990	7.05	0.44						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
2	19	4	Running/end run	13:30	25.5	20.6	31.5		31.5	12.8	591	272	0.24	0.015	7,541	8,573	7.56	0.47						90	477	759	2.14	0.07	6,087	23,922	67.45	2.21									
2	20	0	Column Start-up	8:30	0	0.0	0.0		0.0	0.0	627	280	0.58	0.04	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
2	20	1	In Failure	8:30	24	20.6	29.7	15.1	14.6	5.9	627	280	0.58	0.04	3,697	4,078	8.45	0.58						90	477	759	2.14	0.07	2,813	11,054	31.17	1.02									
2	20	1	2" Media Replaced	15:30-16:45	0	20.6	0.0		0.0	0.0	627	280	0.58	0.04	0	0	0.00	0.00	43	25,448	28,804	30.26	1.95	90	477	759	2.14	0.07	0	0	0.00	0.00	20,368	80,052	225.71	7.38	47.4	124.9	36.0	13.4	26.4
2	20	2	Running	8:30	22.75	19.7	26.9		26.9	10.9	627	280	0.58	0.04	6,826	7,529	15.60	1.08						90	477	759	2.14	0.07	5,193	20,410	57.55	1.88									
2	20	3	In Failure	8:30	24	20.7	29.8		29.8	12.1	627	280	0.58	0.04	7,567	8,346	17.29	1.19						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
2	20	3	6" Media Replaced	11:30-12:30	0	20.7	0.0		0.0	0.0	627	280	0.58	0.04	0	0	0.00	0.00	23	14,393	15,876	32.89	2.27	90	477	759	2.14	0.07	0	0	0.00	0.00	10,949	43,034	121.33	3.97	25.5	131.4	36.9	27.1	57.1
2	20	4	Running	8:30	23	20.6	28.4		28.4	11.5	627	280	0.58	0.04	7,216	7,960	16.49	1.14						90	477	759	2.14	0.07	5,490	21,577	60.84	1.99									
2	20	5	Running	8:30	24	20.8	30.0		30.0	12.1	627	280	0.58	0.04	7,603	8,387	17.37	1.20						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
2	20	6	Running/end run	9:00	24.5	20.8	30.6		30.6	12.4	627	280	0.58	0.04	7,762	8,561	17.73	1.22						90	477	759	2.14	0.07	5,905	23,207	65.43	2.14									
2	21	0	Column Start-up	9:00	0	0.0	0.0		0.0	0.0	156	85	0.30	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
2	21	1	Running	9:00	24	19.7	28.4		28.4	11.5	156	85	0.30	0.015	1,792	2,411	8.51	0.43						90	477	759	2.14	0.07	5,478	21,531	60.71	1.99									
2	21	2	Running	9:00	24	19.7	28.4		28.4	11.5	156	85	0.30	0.015	1,792	2,411	8.51	0.43						90	477	759	2.14	0.07	5,478	21,531	60.71	1.99									
2	21	3	Running	9:00	24	19.8	28.5		28.5	11.5	156	85	0.30	0.015	1,801	2,424	8.55	0.43						90	477	759	2.14	0.07	5,506	21,641	61.02	2.00									
2	21	4	Running	9:00	24	20.9	30.1		30.1	12.2	156	85	0.30	0.015	1,901	2,558	9.03	0.45						90	477	759	2.14	0.07	5,812	22,843	64.41	2.11									
2	21	5	Running	9:00	24	20.6	29.7		29.7	12.0	156	85	0.30	0.015	1,874	2,521	8.90	0.44						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
2	21	6	Running/end run	10:00	25	20.3	30.5		30.5	12.3	156	85	0.30	0.015	1,923	2,588	9.14	0.46						90	477	759	2.14	0.07	5,880	23,112	65.16	2.13									
2	22	0	Column Start-up	8:00	0	0.0	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
2	22	1	Running	8:00	24	20.2	29.1		29.1	11.8	266	134	0.32	0.14	3,133	3,898	9.31	4.07						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
2	22	2	Running	8:00	24	20.1	28.9		28.9	11.7	266	134	0.32	0.14	3,117	3,878	9.26	4.05						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
2	22	3	In Failure	8:00	24	20.4	29.4		29.4	11.9	266	134	0.32	0.14	3,164	3,936	9.40	4.11						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
2	22	3	Sand Cap Replaced	11:00-12:00	0	20.4	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00	142	43,076	51,534	132.20	18.43	90	477	759	2.14	0.07	0	0	0.00	0.00	67,943	267,033	752.90	24.63	158.3	63.4	19.3	17.6	74.8
2	22	4	Running	8:00	23	20.6	28.4		28.4	11.5	266	134	0.32	0.14	3,061	3,809	9.10	3.98						90	477	759	2.14	0.07	5,490	21,577	60.84	1.99									
2	22	5	Running	8:00	24	20.3	29.2		29.2	11.8	266	134	0.32	0.14	3,148	3,917	9.35	4.09						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
2	22	6	Running	8:00	24	20.1	28.9		28.9	11.7	266	134	0.32	0.14	3,117	3,878	9.26	4.05						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
2	22	7	Running/end run	8:30	24.5	20.0	29.4		29.4	11.9	266	134	0.32	0.14	3,166	3,940	9.41	4.12						90	477	759	2.14	0.07	5,678	22,315	62.92	2.06									
2	23	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	198	128	0.34	0.28	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
2	23	1	Running	10:00	24	20.0	28.8		28.8	11.7	198	128	0.34	0.28	2,309	3,686	9.79	8.06						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
2	23	2	Running	10:00	24	20.1	28.9		28.9	11.7	198	128	0.34	0.28	2,320	3,705	9.84	8.10						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
2	23	3	Running	10:00	24	20.2	29.1		29.1	11.8	198	128	0.34	0.28	2,332	3,723	9.89	8.14						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
2	23	4	Running	10:00	24	20.0	28.8		28.8	11.7	198	128	0.34	0.28	2,309	3,686	9.79	8.06						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
2	23	5	Running	10:00	24	20.1	28.9		28.9	11.7	198	128	0.34	0.28	2,320	3,705	9.84	8.10						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
2	23	6	Running	10:00	24	20.2	29.1		29.1	11.8	198	128	0.34	0.28	2,332	3,723	9.89	8.14						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
2	23	7	In Failure	10:00	24	20.3	29.2	1.0	28.3	11.5	198	128	0.34	0.28	2,267	3,620	9.62	7.92						90	477	759	2.14	0.07	5,462	21,466	60.52	1.98									
2	24	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
2	24	1	In Failure	10:00	24	20.8	30.0	15.1	14.8	6.0	330	162	0.55	0.32	1,979	2,400	8.15	4.74						90	477	759	2.14	0.07	2,860	11,242	31.70	1.04									
2	24	1	Sand Cap Replaced	13:15-13:45	0	20.8	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00	135	30,660	43,793	113.93	77.53	90	477	759	2.14	0.07	0	0	0.00	0.00	64,262	252,566	712.11	23.29	149.7	47.7	17.3	16.0	332.8
2	24	2	In Failure	9:00	22.5	20.2	27.3	11.4	15.9	6.4	330	162	0.55	0.32	2,126	2,577	8.75	5.09						90	477	759	2.14	0.07	3,072	12,076	34.05	1.11									
2	24	2	1" Media Replaced	9:15-9:45	0	20.2	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00	6	2,126	2,577	8.75	5.09	90	477	759	2.14	0.07	0	0	0.00	0.00	3,072	12,076	34.05	1.11	7.2	69.2	21.3	25.7	457.1
2	24	3	In Failure	10:00	24.5	20.1	29.5	3.8	25.7	10.4	330	162	0.55	0.32	3,440	4,171	14.16	8.24						90	477	759	2.14	0.07	4,972	19,542	55.10	1.80									
2	24	4	In Failure	10:00	24	20.2	29.1	13.2	15.9	6.4	330	162	0.55	0.32	2,123	2,574	8.74	5.08						90	477	759	2.14	0.07	3,068	12,059	34.00	1.11									
2	24	4	6" Media Replaced	10:30-11:30	0	20.2	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00	17	5,563	6,745	22.90	13.32	90	477	759	2.14	0.07	0	0	0.00	0.00	8,040	31,601	89.10	2.91	18.7	69.2	21.3	25.7	457.1
2	24	5	Running	10:00	23	20.1	27.7		27.7	11.2	330	162	0.55	0.32	3,706	4,494	15.26	8.88						90	477	759	2.14	0.07	5,357	21,053	59.36	1.94									
2	24	6	Running	10:00	24	20.5	29.5		29.5	12.0	330	162	0.55	0.32	3,944	4,782	16.24	9.45						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
2	24	7	Running/end run	10:00	24	20.6	29.7		29.7	12.0	330	162	0.55	0.32	3,963	4,806	16.32	9.49	35	11,613	14,081	47.81	27.82	90	477	759	2.14	0.07	5,729	22,515	63.48	2.08	16,786	65,974	186.01	6.08					
								Sum =	1,252	507			Project totals =		148,966	180,568	418	150	507	148,966	180,568	418	150						241,861	950,576	2,680	87.7	241,861	950,576	2680	87.7					

Table B-4. 4-Inch Scale Filter Column Loading Calculations, Column 3, Existing F-105 Fine Sand

(Existing F-105 Fine Sand)

Column Status and Filtration Volumes											Average Clarifier Concentration				Calculated Load				Calculated Load at Failure/Activity					"Typical" Tahoe Storm Water Concentrations					Calculated "Typical" Tahoe Load				Calculated "Tahoe" Load at Failure/Activity				Percent of "Typical" Tahoe Storm Water Treated				
Col	Run #	Run Day	Status/Activity	Time	Hours In-Service (hrs)	Average Flowrate (ml/min)	Calc Vol. Filtered (L)	Overflow Adjust (L)	**Volume Filtered (L)**	**Feet Filtered (ft)**	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Total Filter Load (ft)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (ft)	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (% of annual)	Turb (%)	TSS (%)	Tot-P (%)	Dis-P (%)
3	18	0	Column Start-up	8:20	0	0.0	0.0		0.0	0.0	106	44	0.10	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
3	18	1	Running	8:20	24	19.7	28.4		28.4	11.5	106	44	0.10	0.015	1,217	1,248	2.84	0.43						90	477	759	2.14	0.07	5,478	21,531	60.71	1.99									
3	18	2	Running	8:20	24	20.4	29.4		29.4	11.9	106	44	0.10	0.015	1,261	1,293	2.94	0.44						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
3	18	3	Running	8:20	24	20.8	30.0		30.0	12.1	106	44	0.10	0.015	1,285	1,318	3.00	0.45						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
3	18	4	Running	8:20	24	19.8	28.5		28.5	11.5	106	44	0.10	0.015	1,224	1,255	2.85	0.43						90	477	759	2.14	0.07	5,506	21,641	61.02	2.00									
3	18	5	Running	8:20	24	19.8	28.5		28.5	11.5	106	44	0.10	0.015	1,224	1,255	2.85	0.43						90	477	759	2.14	0.07	5,506	21,641	61.02	2.00									
3	18	6	Running	8:20	23	20.9	28.8		28.8	11.7	106	44	0.10	0.015	1,238	1,269	2.88	0.43						90	477	759	2.14	0.07	5,570	21,891	61.72	2.02									
3	18	7	Running	8:20	24	20.6	29.7		29.7	12.0	106	44	0.10	0.015	1,273	1,305	2.97	0.44						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
3	18	8	Running/end run	8:15	24	21.0	30.2		30.2	12.2	106	44	0.10	0.015	1,298	1,331	3.02	0.45						90	477	759	2.14	0.07	5,840	22,952	64.71	2.12									
3	19	0	Column Start-up	12:00	0	0.0	0.0		0.0	0.0	591	272	0.24	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
3	19	1	In Failure	8:30	20.5	20.6	25.3	11.4	13.9	5.6	591	272	0.24	0.015	3,335	3,791	3.35	0.21						90	477	759	2.14	0.07	2,692	10,579	29.83	0.98									
3	19	1	Sand Cap Replaced	8:30-11:00	0	20.6	0.0		0.0	0.0	591	272	0.24	0.015	0	0	0.00	0.00	100	13,354	14,064	26.69	3.71	90	477	759	2.14	0.07	0	0	0.00	0.00	47,778	187,780	529.4	17.3	111.3	28.0	7.5	5.0	21.4
3	19	1	Running	12:00	1	20.6	1.2		1.2	0.5	591	272	0.24	0.015	296	336	0.30	0.02						90	477	759	2.14	0.07	239	938	2.65	0.09									
3	19	2	Running	12:00	24	20.3	29.2		29.2	11.8	591	272	0.24	0.015	6,994	7,951	7.02	0.44						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
3	19	3	Running	12:00	24	20.3	29.2		29.2	11.8	591	272	0.24	0.015	6,994	7,951	7.02	0.44						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
3	19	4	Running/end run	13:30	25.5	20.3	31.1		31.1	12.6	591	272	0.24	0.015	7,432	8,448	7.45	0.47						90	477	759	2.14	0.07	5,998	23,574	66.47	2.17									
3	20	0	Column Start-up	8:30	0	0.0	0.0		0.0	0.0	627	280	0.58	0.04	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
3	20	1	Running	8:30	24	20.6	29.7		29.7	12.0	627	280	0.58	0.04	7,530	8,306	17.21	1.19						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
3	20	2	Running	8:30	24	20.2	29.1		29.1	11.8	627	280	0.58	0.04	7,384	8,145	16.87	1.16						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
3	20	3	Running	8:30	24	20.3	29.2		29.2	11.8	627	280	0.58	0.04	7,420	8,185	16.95	1.17						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
3	20	4	Running	8:30	24	20.0	28.8		28.8	11.7	627	280	0.58	0.04	7,311	8,064	16.70	1.15						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
3	20	5	Running	8:30	24	20.0	28.8		28.8	11.7	627	280	0.58	0.04	7,311	8,064	16.70	1.15						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
3	20	6	Running/end run	9:00	24.5	20.0	29.4		29.4	11.9	627	280	0.58	0.04	7,463	8,232	17.05	1.18						90	477	759	2.14	0.07	5,678	22,315	62.92	2.06									
3	21	0	Column Start-up	9:00	0	0.0	0.0		0.0	0.0	156	85	0.30	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
3	21	1	Running	9:00	24	19.5	28.1		28.1	11.4	156	85	0.30	0.015	1,773	2,387	8.42	0.42						90	477	759	2.14	0.07	5,423	21,313	60.09	1.97									
3	21	2	Running	9:00	24	19.8	28.5		28.5	11.5	156	85	0.30	0.015	1,801	2,424	8.55	0.43						90	477	759	2.14	0.07	5,506	21,641	61.02	2.00									
3	21	3	Running	9:00	24	19.7	28.4		28.4	11.5	156	85	0.30	0.015	1,792	2,411	8.51	0.43						90	477	759	2.14	0.07	5,478	21,531	60.71	1.99									
3	21	4	Running	9:00	24	20.8	30.0		30.0	12.1	156	85	0.30	0.015	1,892	2,546	8.99	0.45						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
3	21	5	Running	9:00	24	20.3	29.2		29.2	11.8	156	85	0.30	0.015	1,846	2,485	8.77	0.44						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
3	21	6	Running/end run	10:00	25	20.7	31.1		31.1	12.6	156	85	0.30	0.015	1,961	2,639	9.32	0.47						90	477	759	2.14	0.07	5,996	23,567	66.45	2.17									
3	22	0	Column Start-up	8:00	0	0.0	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
3	22	1	Running	8:00	24	20.2	29.1		29.1	11.8	266	134	0.32	0.14	3,133	3,898	9.31	4.07						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
3	22	2	Running	8:00	24	20.6	29.7		29.7	12.0	266	134	0.32	0.14	3,195	3,975	9.49	4.15						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
3	22	3	Running	8:00	24	20.5	29.5		29.5	12.0	266	134	0.32	0.14	3,179	3,956	9.45	4.13						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
3	22	4	Running	8:00	24	20.4	29.4		29.4	11.9	266	134	0.32	0.14	3,164	3,936	9.40	4.11						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
3	22	5	In Failure	8:00	24	20.1	28.9		28.9	11.7	266	134	0.32	0.14	3,117	3,878	9.26	4.05						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
3	22	5	Sand Cap Replaced	10:30-11:30	0	20.1	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00	238	92,987	108,217	222.74	31.51	90	477	759	2.14	0.07	0	0	0.00	0.00	113,462	445,935	1257.3	41.1	264.3	82.0	24.3	17.7	76.6
3	22	6	Running	8:00	23	20.3	28.0		28.0	11.3	266	134	0.32	0.14	3,017	3,754	8.96	3.92						90	477	759	2.14	0.07	5,410	21,263	59.95	1.96									
3	22	7	Running/end run	8:30	24.5	20.2	29.7		29.7	12.0	266	134	0.32	0.14	3,198	3,979	9.50	4.16						90	477	759	2.14	0.07	5,734	22,538	63.55	2.08									
3	23	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	198	128	0.34	0.28	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
3	23	1	Running	10:00	24	20.4	29.4		29.4	11.9	198	128	0.34	0.28	2,355	3,760	9.99	8.23						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
3	23	2	Running	10:00	24	20.1	28.9		28.9	11.7	198	128	0.34	0.28	2,320	3,705	9.84	8.10						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
3	23	3	Running	10:00	24	20.2	29.1		29.1	11.8	198	128	0.34	0.28	2,332	3,723	9.89	8.14						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
3	23	4	Running	10:00	24	20.2	29.1		29.1	11.8	198	128	0.34	0.28	2,332	3,723	9.89	8.14						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
3	23	5	Running	10:00	24	20.4	29.4		29.4	11.9	198	128	0.34	0.28	2,355	3,760	9.99	8.23						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
3	23	6	Running	10:00	24	20.6	29.7		29.7	12.0	198	128	0.34	0.28	2,378	3,797	10.09	8.31						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
3	23	7	Running/end run	10:00	24	20.7	29.8		29.8	12.1	198	128	0.34	0.28	2,389	3,815	10.13	8.35						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
3	24	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
3	24	1	Running	10:00	24	20.8	30.0		30.0	12.1	330	162	0.55	0.32	4,002	4,852	16.47	9.58						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
3	24	2	Running	10:00	24	20.2	29.1		29.1	11.8	330	162	0.55	0.32	3,886	4,712	16.00	9.31						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
3	24	3	Running	10:00	24	20.0	28.8		28.8	11.7	330	162	0.55	0.32	3,848	4,666	15.84	9.22						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
3	24	4	Running	10:00	24	20.0	28.8		28.8	11.7	330	162	0.55	0.32	3,848	4,666	15.84	9.22						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
3	24	5	Running	10:00	24	20.1	28.9		28.9	11.7	330	162	0.55	0.32	3,867	4,689	15.92	9.26						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
3	24	6	Running	10:00	24	20.7	29.8		29.8	12.1	330	162	0.55	0.32	3,982	4,829	16.39	9.54		project end				90	477	759	2.14	0.07	5,756	22,624	63.79	2.09		project end							
3	24	7	Running/end run	10:00	24	21.0	30.2		30.2	12.2	330	162	0.55	0.32	4,040	4,899	16.63	9.68	190	50,149	67,329	201.38	131.38	90	477	759	2.14	0.07	5,840	22,952	64.71	2.12	90,511	355,731	1003.0	32.8	210.8	55.4	18.9	20.1	400.4
								Sum =	1,304	528				Project totals =	156,489	189,610	451	167	528	156,489	189,610	451	167						251,751	989,445	2,790	91.3	251,751	989,445	2,790	91.3					

Table B-5. 4-Inch Scale Filter Column Loading Calculations, Column 4, Existing F-105 Fine Sand

(Existing F-105 Fine Sand)

Column Status and Filtration Volumes											Average Clarifier Concentration				Calculated Load				Calculated Load at Failure/Activity					"Typical" Tahoe Storm Water Concentrations					Calculated "Typical" Tahoe Load				Calculated "Tahoe" Load at Failure/Activity				Percent of "Typical" Tahoe Storm Water Treated				
Col	Run #	Run Day	Status/Activity	Time	Hours In-Service (hrs)	Average Flowrate (ml/min)	Calc Vol. Filtered (L)	Overflow Adjust (L)	**Volume Filtered (L)**	**Feet Filtered (ft)**	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Total Filter Load (ft)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (ft)	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (% of annual)	Turb (%)	TSS (%)	Tot-P (%)	Dis-P (%)
4	18	0	Column Start-up	8:20	0	0.0	0.0		0.0	0.0	106	44	0.10	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
4	18	1	Running	8:20	24	19.5	28.1		28.1	11.4	106	44	0.10	0.015	1,205	1,236	2.81	0.42						90	477	759	2.14	0.07	5,423	21,313	60.09	1.97									
4	18	2	Running	8:20	24	19.2	27.6		27.6	11.2	106	44	0.10	0.015	1,187	1,217	2.76	0.41						90	477	759	2.14	0.07	5,339	20,985	59.17	1.94									
4	18	3	Running	8:20	24	19.7	28.4		28.4	11.5	106	44	0.10	0.015	1,217	1,248	2.84	0.43						90	477	759	2.14	0.07	5,478	21,531	60.71	1.99									
4	18	4	Running	8:20	24	18.9	27.2		27.2	11.0	106	44	0.10	0.015	1,168	1,198	2.72	0.41						90	477	759	2.14	0.07	5,256	20,657	58.24	1.91									
4	18	5	Running	8:20	24	19.5	28.1		28.1	11.4	106	44	0.10	0.015	1,205	1,236	2.81	0.42						90	477	759	2.14	0.07	5,423	21,313	60.09	1.97									
4	18	6	In Failure	8:20	24	19.5	28.1	0.8	27.3	11.0	106	44	0.10	0.015	1,171	1,200	2.73	0.41						90	477	759	2.14	0.07	5,268	20,706	58.38	1.91									
4	18	6	Sand Cap Replaced	9:00-10:00	0	19.5	0.0		0.0	0.0	106	44	0.10	0.015	0	0	0.00	0.00	67	7,153	7,334	16.67	2.50	90	477	759	2.14	0.07	0	0	0.00	0.00	32,187	126,504	356.7	11.7	75.0	22.2	5.8	4.7	21.4
4	18	7	Running	8:20	23	20.6	28.4		28.4	11.5	106	44	0.10	0.015	1,220	1,251	2.84	0.43						90	477	759	2.14	0.07	5,490	21,577	60.84	1.99									
4	18	8	Running/end run	8:15	24	21.2	30.5		30.5	12.4	106	44	0.10	0.015	1,310	1,343	3.05	0.46						90	477	759	2.14	0.07	5,895	23,171	65.33	2.14									
4	19	0	Column Start-up	12:00	0	0.0	0.0		0.0	0.0	591	272	0.24	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
4	19	1	Running	12:00	24	20.7	29.8		29.8	12.1	591	272	0.24	0.015	7,132	8,108	7.15	0.45						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
4	19	2	In Failure	8:30	20.5	21.0	25.8	0.5	25.3	10.3	591	272	0.24	0.015	6,061	6,890	6.08	0.38						90	477	759	2.14	0.07	4,892	19,225	54.21	1.77									
4	19	2	Sand Cap Replaced	8:30-10:00	0	21.0	0.0		0.0	0.0	591	272	0.24	0.015	0	0	0.00	0.00	46	15,723	17,592	19.13	1.71	90	477	759	2.14	0.07	0	0	0.00	0.00	22,034	86,597	244.2	8.0	51.3	71.4	20.3	7.8	21.4
4	19	3	Running	12:00	26	21.5	33.5		33.5	13.6	591	272	0.24	0.015	8,025	9,123	8.05	0.50						90	477	759	2.14	0.07	6,477	25,457	71.78	2.35									
4	19	4	Running/end run	13:30	25.5	21.6	33.0		33.0	13.4	591	272	0.24	0.015	7,907	8,989	7.93	0.50						90	477	759	2.14	0.07	6,382	25,083	70.72	2.31									
4	20	0	Column Start-up	8:30	0	0.0	0.0		0.0	0.0	627	280	0.58	0.04	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
4	20	1	Running	8:30	24	20.7	29.8		29.8	12.1	627	280	0.58	0.04	7,567	8,346	17.29	1.19						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
4	20	2	Running	8:30	24	20.5	29.5		29.5	12.0	627	280	0.58	0.04	7,494	8,266	17.12	1.18						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
4	20	3	Running	8:30	24	20.2	29.1		29.1	11.8	627	280	0.58	0.04	7,384	8,145	16.87	1.16						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
4	20	4	Running	8:30	24	20.4	29.4		29.4	11.9	627	280	0.58	0.04	7,457	8,225	17.04	1.18						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
4	20	5	Running	8:30	24	20.2	29.1		29.1	11.8	627	280	0.58	0.04	7,384	8,145	16.87	1.16						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
4	20	6	Running/end run	9:00	24.5	20.2	29.7		29.7	12.0	627	280	0.58	0.04	7,538	8,314	17.22	1.19						90	477	759	2.14	0.07	5,734	22,538	63.55	2.08									
4	21	0	Column Start-up	9:00	0	0.0	0.0		0.0	0.0	156	85	0.30	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
4	21	1	Running	9:00	24	18.4	26.5		26.5	10.7	156	85	0.30	0.015	1,673	2,252	7.95	0.40						90	477	759	2.14	0.07	5,117	20,110	56.70	1.85									
4	21	2	Running	9:00	24	20.3	29.2		29.2	11.8	156	85	0.30	0.015	1,846	2,485	8.77	0.44						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
4	21	3	Running	9:00	24	20.6	29.7		29.7	12.0	156	85	0.30	0.015	1,874	2,521	8.90	0.44						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
4	21	4	Running	9:00	24	19.2	27.6		27.6	11.2	156	85	0.30	0.015	1,746	2,350	8.29	0.41						90	477	759	2.14	0.07	5,339	20,985	59.17	1.94									
4	21	5	Running	9:00	24	19.7	28.4		28.4	11.5	156	85	0.30	0.015	1,792	2,411	8.51	0.43						90	477	759	2.14	0.07	5,478	21,531	60.71	1.99									
4	21	6	Running/end run	10:00	25	20.7	31.1		31.1	12.6	156	85	0.30	0.015	1,961	2,639	9.32	0.47						90	477	759	2.14	0.07	5,996	23,567	66.45	2.17									
4	22	0	Column Start-up	8:00	0	0.0	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
4	22	1	Running	8:00	24	20.6	29.7		29.7	12.0	266	134	0.32	0.14	3,195	3,975	9.49	4.15						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
4	22	2	Running	8:00	24	20.6	29.7		29.7	12.0	266	134	0.32	0.14	3,195	3,975	9.49	4.15						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
4	22	3	Running	8:00	24	20.7	29.8		29.8	12.1	266	134	0.32	0.14	3,210	3,994	9.54	4.17						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
4	22	4	Running	8:00	24	20.5	29.5		29.5	12.0	266	134	0.32	0.14	3,179	3,956	9.45	4.13						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
4	22	5	Running	8:00	24	20.1	28.9		28.9	11.7	266	134	0.32	0.14	3,117	3,878	9.26	4.05						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
4	22	6	Running	8:00	24	20.4	29.4		29.4	11.9	266	134	0.32	0.14	3,164	3,936	9.40	4.11						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
4	22	7	Running/end run	8:30	24.5	20.7	30.4		30.4	12.3	266	134	0.32	0.14	3,277	4,077	9.74	4.26						90	477	759	2.14	0.07	5,876	23,096	65.12	2.13									
4	23	0	Sand Cap Replaced	9:00-10:00	--	--	--		--										252	93,983	110,004	236.50	39.69										120,317	472,876	1333.3	43.6	280.3	78.1	23.3	17.7	91.0
4	23	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	198	128	0.34	0.28	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
4	23	1	Running	10:00	24	21.0	30.2		30.2	12.2	198	128	0.34	0.28	2,424	3,871	10.28	8.47						90	477	759	2.14	0.07	5,840	22,952	64.71	2.12									
4	23	2	Running	10:00	24	20.2	29.1		29.1	11.8	198	128	0.34	0.28	2,332	3,723	9.89	8.14						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
4	23	3	Running	10:00	24	20.0	28.8		28.8	11.7	198	128	0.34	0.28	2,309	3,686	9.79	8.06						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
4	23	4	Running	10:00	24	20.0	28.8		28.8	11.7	198	128	0.34	0.28	2,309	3,686	9.79	8.06						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
4	23	5	Running	10:00	24	20.0	28.8		28.8	11.7	198	128	0.34	0.28	2,309	3,686	9.79	8.06						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
4	23	6	Running	10:00	24	20.0	28.8		28.8	11.7	198	128	0.34	0.28	2,309	3,686	9.79	8.06						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
4	23	7	Running/end run	10:00	24	20.0	28.8		28.8	11.7	198	128	0.34	0.28	2,309	3,686	9.79	8.06						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
4	24	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
4	24	1	Running	10:00	24	20.4	29.4		29.4	11.9	330	162	0.55	0.32	3,925	4,759	16.16	9.40						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
4	24	2	Running	10:00	24	20.6	29.7		29.7	12.0	330	162	0.55	0.32	3,963	4,806	16.32	9.49						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
4	24	3	Running	10:00	24	20.2	29.1		29.1	11.8	330	162	0.55	0.32	3,886	4,712	16.00	9.31						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
4	24	4	Running	10:00	24	20.1	28.9		28.9	11.7	330	162	0.55	0.32	3,867	4,689	15.92	9.26						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
4	24	5	Running	10:00	24	20.6	29.7		29.7	12.0	330	162	0.55	0.32	3,963	4,806	16.32	9.49						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
4	24	6	Running	10:00	24	20.6	29.7		29.7	12.0	330	162	0.55	0.32	3,963	4,806	16.32	9.49		project end				90	477	759	2.14	0.07	5,729	22,515	63.48	2.08		project end							
4	24	7	Running/end run	10:00	24	20.3	29.2		29.2	11.8	330	162	0.55	0.32	3,905	4,736	16.08	9.35	166	43,772	59,338	182.23	122.73	90	477	759	2.14	0.07	5,645	22,187	62.56	2.05	78,977	310,401	875.2	28.6	184.0	55.4	19.1	20.8	428.7
								Sum =	1,313	531			Project totals =		160,631	194,267	455	167	531	160,631	194,267	455	167						253,515	996,378	2,809	91.9	253,515	996,378	2,809	91.9					

Table B-6. 4-Inch Scale Filter Column Loading Calculations, Column 5, Activated Alumina (new 28x48)

(New DD-2 AA, 28x28)

Column Status and Filtration Volumes											Average Clarifier Concentration				Calculated Load				Calculated Load at Failure/Activity					"Typical" Tahoe Storm Water Concentrations					Calculated "Typical" Tahoe Load				Calculated "Tahoe" Load at Failure/Activity				Percent of "Typical" Tahoe Storm Water Treated				
Col	Run #	Run Day	Status/Activity	Time	Hours In-Service (hrs)	Average Flowrate (ml/min)	Calc Vol. Filtered (L)	Overflow Adjust (L)	**Volume Filtered (L)**	**Feet Filtered (ft)**	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Total Filter Load (ft)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (ft)	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (% of annual)	Turb (%)	TSS (%)	Tot-P (%)	Dis-P (%)
5	18	0	Column Start-up	8:20	0	0.0	0.0		0.0	0.0	106	44	0.10	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
5	18	1	Running	8:20	24	19.5	28.1		28.1	11.4	106	44	0.10	0.015	1,205	1,236	2.81	0.42						90	477	759	2.14	0.07	5,423	21,313	60.09	1.97									
5	18	2	Running	8:20	24	20.4	29.4		29.4	11.9	106	44	0.10	0.015	1,261	1,293	2.94	0.44						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
5	18	3	Running	8:20	24	20.5	29.5		29.5	12.0	106	44	0.10	0.015	1,267	1,299	2.95	0.44						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
5	18	4	Running	8:20	24	20.2	29.1		29.1	11.8	106	44	0.10	0.015	1,248	1,280	2.91	0.44						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
5	18	5	Running	8:20	24	20.6	29.7		29.7	12.0	106	44	0.10	0.015	1,273	1,305	2.97	0.44						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
5	18	6	Running	8:20	24	19.2	27.6		27.6	11.2	106	44	0.10	0.015	1,187	1,217	2.76	0.41						90	477	759	2.14	0.07	5,339	20,985	59.17	1.94									
5	18	7	Running	8:20	24	20.8	30.0		30.0	12.1	106	44	0.10	0.015	1,285	1,318	3.00	0.45						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
5	18	8	Running/end run	8:15	24	21.3	30.7		30.7	12.4	106	44	0.10	0.015	1,316	1,350	3.07	0.46						90	477	759	2.14	0.07	5,923	23,280	65.64	2.15									
5	19	0	Sand Cap Replaced	10:00-11:00	--	--	--		--										95	10,042	10,296	23.40	3.51										45,189	177,606	500.8	16.4	105.3	22.2	5.8	4.7	21.4
5	19	0	Column Start-up	12:00	0	0.0	0.0		0.0	0.0	591	272	0.24	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
5	19	1	Running	12:00	24	21.1	30.4		30.4	12.3	591	272	0.24	0.015	7,270	8,264	7.29	0.46						90	477	759	2.14	0.07	5,868	23,061	65.02	2.13									
5	19	2	Running	12:00	24	21.2	30.5		30.5	12.4	591	272	0.24	0.015	7,304	8,304	7.33	0.46						90	477	759	2.14	0.07	5,895	23,171	65.33	2.14									
5	19	3	Running	12:00	24	20.9	30.1		30.1	12.2	591	272	0.24	0.015	7,201	8,186	7.22	0.45						90	477	759	2.14	0.07	5,812	22,843	64.41	2.11									
5	19	4	Running/end run	13:30	25.5	20.6	31.5		31.5	12.8	591	272	0.24	0.015	7,541	8,573	7.56	0.47						90	477	759	2.14	0.07	6,087	23,922	67.45	2.21									
5	20	0	Column Start-up	8:30	0	0.0	0.0		0.0	0.0	627	280	0.58	0.04	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
5	20	1	Running	8:30	24	20.8	30.0		30.0	12.1	627	280	0.58	0.04	7,603	8,387	17.37	1.20						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
5	20	2	Running	8:30	24	20.0	28.8		28.8	11.7	627	280	0.58	0.04	7,311	8,064	16.70	1.15						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
5	20	3	Running	8:30	24	19.7	28.4		28.4	11.5	627	280	0.58	0.04	7,201	7,943	16.45	1.13						90	477	759	2.14	0.07	5,478	21,531	60.71	1.99									
5	20	4	Running	8:30	24	19.9	28.7		28.7	11.6	627	280	0.58	0.04	7,274	8,024	16.62	1.15						90	477	759	2.14	0.07	5,534	21,750	61.32	2.01									
5	20	5	In Failure	8:30	24	20.2	29.1	2.5	26.6	10.8	627	280	0.58	0.04	6,749	7,445	15.42	1.06						90	477	759	2.14	0.07	5,135	20,180	56.90	1.86									
5	20	5	Sand Cap Replaced	9:30-10:30	0	20.2	0.0		0.0	0.0	627	280	0.58	0.04	0	0	0.00	0.00	107	65,456	73,189	111.98	7.53	90	477	759	2.14	0.07	0	0	0.00	0.00	51,155	201,052	566.9	18.5	119.2	128.0	36.4	19.8	40.6
5	20	6	Running/end run	9:00	23.5	20.3	28.6		28.6	11.6	627	280	0.58	0.04	7,266	8,014	16.60	1.14						90	477	759	2.14	0.07	5,528	21,725	61.25	2.00									
5	21	0	Column Start-up	9:00	0	0.0	0.0		0.0	0.0	156	85	0.30	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
5	21	1	Running	9:00	24	20.4	29.4		29.4	11.9	156	85	0.30	0.015	1,855	2,497	8.81	0.44						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
5	21	2	Running	9:00	24	19.8	28.5		28.5	11.5	156	85	0.30	0.015	1,801	2,424	8.55	0.43						90	477	759	2.14	0.07	5,506	21,641	61.02	2.00									
5	21	3	Running	9:00	24	19.6	28.2		28.2	11.4	156	85	0.30	0.015	1,783	2,399	8.47	0.42						90	477	759	2.14	0.07	5,451	21,422	60.40	1.98									
5	21	4	Running	9:00	24	19.4	27.9		27.9	11.3	156	85	0.30	0.015	1,764	2,375	8.38	0.42						90	477	759	2.14	0.07	5,395	21,203	59.78	1.96									
5	21	5	Running	9:00	24	20.2	29.1		29.1	11.8	156	85	0.30	0.015	1,837	2,472	8.73	0.44						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
5	21	6	Running/end run	10:00	25	20.3	30.5		30.5	12.3	156	85	0.30	0.015	1,923	2,588	9.14	0.46						90	477	759	2.14	0.07	5,880	23,112	65.16	2.13									
5	22	0	Column Start-up	8:00	0	0.0	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
5	22	1	In Failure	8:00	24	20.8	30.0		30.0	12.1	266	134	0.32	0.14	3,226	4,014	9.58	4.19						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
5	22	1	Sand Cap Replaced	10:00-11:00	0	20.8	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00	94	21,455	26,783	78.26	7.94	90	477	759	2.14	0.07	0	0	0.00	0.00	44,834	176,210	496.8	16.3	104.4	47.9	15.2	15.8	48.9
5	22	2	Running	8:00	23	20.4	28.2		28.2	11.4	266	134	0.32	0.14	3,032	3,772	9.01	3.94						90	477	759	2.14	0.07	5,437	21,367	60.25	1.97									
5	22	3	Running	8:00	24	20.5	29.5		29.5	12.0	266	134	0.32	0.14	3,179	3,956	9.45	4.13						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
5	22	4	Running	8:00	24	20.5	29.5		29.5	12.0	266	134	0.32	0.14	3,179	3,956	9.45	4.13						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
5	22	5	Running	8:00	24	20.0	28.8		28.8	11.7	266	134	0.32	0.14	3,102	3,859	9.22	4.03						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
5	22	6	Running	8:00	24	20.1	28.9		28.9	11.7	266	134	0.32	0.14	3,117	3,878	9.26	4.05						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
5	22	7	Running/end run	8:30	24.5	20.3	29.8		29.8	12.1	266	134	0.32	0.14	3,214	3,999	9.55	4.18						90	477	759	2.14	0.07	5,763	22,649	63.86	2.09									
5	23	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	198	128	0.34	0.28	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
5	23	1	Running	10:00	24	20.9	30.1		30.1	12.2	198	128	0.34	0.28	2,413	3,852	10.23	8.43						90	477	759	2.14	0.07	5,812	22,843	64.41	2.11									
5	23	2	Running	10:00	24	20.4	29.4		29.4	11.9	198	128	0.34	0.28	2,355	3,760	9.99	8.23						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
5	23	3	Running	10:00	24	20.1	28.9		28.9	11.7	198	128	0.34	0.28	2,320	3,705	9.84	8.10						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
5	23	4	Running	10:00	24	20.3	29.2		29.2	11.8	198	128	0.34	0.28	2,343	3,742	9.94	8.18						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
5	23	5	Running	10:00	24	20.2	29.1		29.1	11.8	198	128	0.34	0.28	2,332	3,723	9.89	8.14						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
5	23	6	Running	10:00	24	20.1	28.9		28.9	11.7	198	128	0.34	0.28	2,320	3,705	9.84	8.10						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
5	23	7	Running/end run	10:00	24	20.0	28.8		28.8	11.7	198	128	0.34	0.28	2,309	3,686	9.79	8.06						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
5	24	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
5	24	1	In Failure	10:00	24	20.4	29.4	11.4	18.0	7.3	330	162	0.55	0.32	2,402	2,912	9.89	5.75						90	477	759	2.14	0.07	3,471	13,644	38.47	1.26									
5	24	1	Sand Cap Replaced	13:45-14:15	0	20.4	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00	161	37,615	52,506	135.34	87.48	90	477	759	2.14	0.07	0	0	0.00	0.00	76,713	301,500	850.1	27.8	178.7	49.0	17.4	15.9	314.6
5	24	2	In Failure	10:00	23.5	20.6	29.0	7.6	21.4	8.7	330	162	0.55	0.32	2,865	3,474	11.80	6.86						90	477	759	2.14	0.07	4,142	16,278	45.89	1.50									
5	24	3	In Failure	10:00	24	20.3	29.2	18.9	10.3	4.2	330	162	0.55	0.32	1,380	1,674	5.68	3.31						90	477	759	2.14	0.07	1,995	7,842	22.11	0.72									
5	24	4	In Failure	10:00	24	20.1	28.9	13.2	15.7	6.4	330	162	0.55	0.32	2,103	2,551	8.66	5.04						90	477	759	2.14	0.07	3,040	11,950	33.69	1.10									
5	24	4	1" Media Replaced	12:30-13:30	0	20.1	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00	19	6,349	7,699	26.14	15.21	90	477	759	2.14	0.07	0	0	0.00	0.00	9,177	36,069	101.7	3.3	21.4	69.2	21.3	25.7	457.1
5	24	5	Running	10:00	23	20.6	28.4		28.4	11.5	330	162	0.55	0.32	3,798	4,605	15.64	9.10						90	477	759	2.14	0.07	5,490	21,577	60.84	1.99									
5	24	6	Running	10:00	24	20.6	29.7		29.7	12.0	330	162	0.55	0.32	3,963	4,806	16.32	9.49						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
5	24	7	Running/end run	10:00	24	20.3	29.2		29.2	11.8	330	162	0.55	0.32	3,905	4,736	16.08	9.35	35	11,667	14,146	48.03	27.94	90	477	759	2.14	0.07	5,645	22,187	62.56	2.05	16,864	66,279	186.9	6.1					
								Sum =	1,263	511			Project totals =		152,584	184,619	423	150	511	152,584	184,619	423	150						243,932	958,716	2,703	88.4	243,932	958,716	2,703	88.4					

Table B-7. 4-Inch Scale Filter Column Loading Calculations, Column 6, Activated Alumina (new 28x48)

(New DD-2 AA, 28x28)

Column Status and Filtration Volumes											Average Clarifier Concentration				Calculated Load				Calculated Load at Failure/Activity					"Typical" Tahoe Storm Water Concentrations					Calculated "Typical" Tahoe Load				Calculated "Tahoe" Load at Failure/Activity				Percent of "Typical" Tahoe Storm Water Treated				
Col	Run #	Run Day	Status/Activity	Time	Hours In-Service (hrs)	Average Flowrate (ml/min)	Calc Vol. Filtered (L)	Overflow Adjust (L)	**Volume Filtered (L)**	**Feet Filtered (ft)**	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Total Filter Load (ft)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (ft)	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (% of annual)	Turb (%)	TSS (%)	Tot-P (%)	Dis-P (%)
6	18	0	Column Start-up	8:20	0	0.0	0.0		0.0	0.0	106	44	0.10	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
6	18	1	Running	8:20	24	19.9	28.7		28.7	11.6	106	44	0.10	0.015	1,230	1,261	2.87	0.43						90	477	759	2.14	0.07	5,534	21,750	61.32	2.01									
6	18	2	Running	8:20	24	21.2	30.5		30.5	12.4	106	44	0.10	0.015	1,310	1,343	3.05	0.46						90	477	759	2.14	0.07	5,895	23,171	65.33	2.14									
6	18	3	Running	8:20	24	20.6	29.7		29.7	12.0	106	44	0.10	0.015	1,273	1,305	2.97	0.44						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
6	18	4	Running	8:20	24	20.7	29.8		29.8	12.1	106	44	0.10	0.015	1,279	1,312	2.98	0.45						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
6	18	5	Running	8:20	24	21.1	30.4		30.4	12.3	106	44	0.10	0.015	1,304	1,337	3.04	0.46						90	477	759	2.14	0.07	5,868	23,061	65.02	2.13									
6	18	6	Running	8:20	24	19.6	28.2		28.2	11.4	106	44	0.10	0.015	1,211	1,242	2.82	0.42						90	477	759	2.14	0.07	5,451	21,422	60.40	1.98									
6	18	7	Running	8:20	24	20.8	30.0		30.0	12.1	106	44	0.10	0.015	1,285	1,318	3.00	0.45						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
6	18	8	Running/end run	8:15	24	21.2	30.5		30.5	12.4	106	44	0.10	0.015	1,310	1,343	3.05	0.46						90	477	759	2.14	0.07	5,895	23,171	65.33	2.14									
6	19	0	Column Start-up	12:00	0	0.0	0.0		0.0	0.0	591	272	0.24	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
6	19	1	In Failure	8:30	20.5	21.3	26.2	9.5	16.7	6.8	591	272	0.24	0.015	3,996	4,542	4.01	0.25						90	477	759	2.14	0.07	3,225	12,675	35.74	1.17									
6	19	1	Sand Cap Replaced	8:30-11:00	0	21.3	0.0		0.0	0.0	591	272	0.24	0.015	0	0	0.00	0.00	103	14,198	15,003	27.78	3.82	90	477	759	2.14	0.07	0	0	0.00	0.00	49,137	193,122	544.5	17.8	114.5	28.9	7.8	5.1	21.4
6	19	1	Running	12:00	1	21.3	1.3		1.3	0.5	591	272	0.24	0.015	306	348	0.31	0.02						90	477	759	2.14	0.07	247	970	2.73	0.09									
6	19	2	Running	12:00	24	21.1	30.4		30.4	12.3	591	272	0.24	0.015	7,270	8,264	7.29	0.46						90	477	759	2.14	0.07	5,868	23,061	65.02	2.13									
6	19	3	Running	12:00	24	21.4	30.8		30.8	12.5	591	272	0.24	0.015	7,373	8,382	7.40	0.46						90	477	759	2.14	0.07	5,951	23,389	65.95	2.16									
6	19	4	Running/end run	13:30	25.5	21.6	33.0		33.0	13.4	591	272	0.24	0.015	7,907	8,989	7.93	0.50						90	477	759	2.14	0.07	6,382	25,083	70.72	2.31									
6	20	0	Column Start-up	8:30	0	0.0	0.0		0.0	0.0	627	280	0.58	0.04	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
6	20	1	Running	8:30	24	20.4	29.4		29.4	11.9	627	280	0.58	0.04	7,457	8,225	17.04	1.18						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
6	20	2	Running	8:30	24	20.3	29.2		29.2	11.8	627	280	0.58	0.04	7,420	8,185	16.95	1.17						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
6	20	3	Running	8:30	24	20.3	29.2		29.2	11.8	627	280	0.58	0.04	7,420	8,185	16.95	1.17						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
6	20	4	Running	8:30	24	20.1	28.9		28.9	11.7	627	280	0.58	0.04	7,347	8,104	16.79	1.16						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
6	20	5	Running	8:30	24	19.9	28.7		28.7	11.6	627	280	0.58	0.04	7,274	8,024	16.62	1.15						90	477	759	2.14	0.07	5,534	21,750	61.32	2.01									
6	20	6	Running/end run	9:00	24.5	20.0	29.4		29.4	11.9	627	280	0.58	0.04	7,463	8,232	17.05	1.18						90	477	759	2.14	0.07	5,678	22,315	62.92	2.06									
6	21	0	Column Start-up	9:00	0	0.0	0.0		0.0	0.0	156	85	0.30	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
6	21	1	Running	9:00	24	19.0	27.4		27.4	11.1	156	85	0.30	0.015	1,728	2,326	8.21	0.41						90	477	759	2.14	0.07	5,284	20,766	58.55	1.92									
6	21	2	Running	9:00	24	19.8	28.5		28.5	11.5	156	85	0.30	0.015	1,801	2,424	8.55	0.43						90	477	759	2.14	0.07	5,506	21,641	61.02	2.00									
6	21	3	In Failure	9:00	24	20.0	28.8		28.8	11.7	156	85	0.30	0.015	1,819	2,448	8.64	0.43						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
6	21	3	Sand Cap Replaced	3:30-4:30	0	20.0	0.0		0.0	0.0	156	85	0.30	0.015	0	0	0.00	0.00	144	72,587	82,135	149.74	9.70	90	477	759	2.14	0.07	0	0	0.00	0.00	68,564	269,474	759.8	24.9	159.7	105.9	30.5	19.7	39.0
6	21	4	Running	9:00	23	19.6	27.0		27.0	11.0	156	85	0.30	0.015	1,708	2,299	8.11	0.41						90	477	759	2.14	0.07	5,223	20,529	57.88	1.89									
6	21	5	Running	9:00	24	20.1	28.9		28.9	11.7	156	85	0.30	0.015	1,828	2,460	8.68	0.43						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
6	21	6	Running/end run	10:00	25	20.0	30.0		30.0	12.1	156	85	0.30	0.015	1,895	2,550	9.00	0.45						90	477	759	2.14	0.07	5,794	22,770	64.20	2.10									
6	22	0	Column Start-up	8:00	0	0.0	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
6	22	1	Running	8:00	24	20.6	29.7		29.7	12.0	266	134	0.32	0.14	3,195	3,975	9.49	4.15						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
6	22	2	Running	8:00	24	20.6	29.7		29.7	12.0	266	134	0.32	0.14	3,195	3,975	9.49	4.15						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
6	22	3	Running	8:00	24	20.7	29.8		29.8	12.1	266	134	0.32	0.14	3,210	3,994	9.54	4.17						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
6	22	4	Running	8:00	24	20.6	29.7		29.7	12.0	266	134	0.32	0.14	3,195	3,975	9.49	4.15						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
6	22	5	In Failure	8:00	24	20.2	29.1		29.1	11.8	266	134	0.32	0.14	3,133	3,898	9.31	4.07						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
6	22	5	Sand Cap Replaced	11:30-12:15	0	20.2	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00	95	21,357	27,126	73.12	21.99	90	477	759	2.14	0.07	0	0	0.00	0.00	45,166	177,515	500.5	16.4	105.2	47.3	15.3	14.6	134.3
6	22	6	Running	8:00	23.25	20.3	28.3		28.3	11.5	266	134	0.32	0.14	3,050	3,795	9.06	3.96						90	477	759	2.14	0.07	5,469	21,494	60.60	1.98									
6	22	7	Running/end run	8:30	24.5	20.7	30.4		30.4	12.3	266	134	0.32	0.14	3,277	4,077	9.74	4.26						90	477	759	2.14	0.07	5,876	23,096	65.12	2.13									
6	23	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	198	128	0.34	0.28	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
6	23	1	Running	10:00	24	20.6	29.7		29.7	12.0	198	128	0.34	0.28	2,378	3,797	10.09	8.31						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
6	23	2	Running	10:00	24	20.6	29.7		29.7	12.0	198	128	0.34	0.28	2,378	3,797	10.09	8.31						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
6	23	3	Running	10:00	24	20.4	29.4		29.4	11.9	198	128	0.34	0.28	2,355	3,760	9.99	8.23						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
6	23	4	Running	10:00	24	20.1	28.9		28.9	11.7	198	128	0.34	0.28	2,320	3,705	9.84	8.10						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
6	23	5	Running	10:00	24	20.0	28.8		28.8	11.7	198	128	0.34	0.28	2,309	3,686	9.79	8.06						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
6	23	6	Running	10:00	24	20.0	28.8		28.8	11.7	198	128	0.34	0.28	2,309	3,686	9.79	8.06						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
6	23	7	Running/end run	10:00	24	20.0	28.8		28.8	11.7	198	128	0.34	0.28	2,309	3,686	9.79	8.06						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
6	24	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
6	24	1	In Failure	10:00	24	20.1	28.9	1.9	27.0	10.9	330	162	0.55	0.32	3,613	4,381	14.87	8.65						90	477	759	2.14	0.07	5,223	20,526	57.87	1.89									
6	24	1	Sand Cap Replaced	13:45-14:15	0	20.1	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00	117	26,297	38,371	103.05	74.01	90	477	759	2.14	0.07	0	0	0.00	0.00	55,973	219,988	620.3	20.3	130.4	47.0	17.4	16.6	364.8
6	24	2	In Failure	10:00	23.5	20.4	28.8	7.6	21.2	8.6	330	162	0.55	0.32	2,828	3,429	11.64	6.77						90	477	759	2.14	0.07	4,087	16,063	45.29	1.48									
6	24	3	In Failure	10:00	24	20.3	29.2	18.9	10.3	4.2	330	162	0.55	0.32	1,380	1,674	5.68	3.31						90	477	759	2.14	0.07	1,995	7,842	22.11	0.72									
6	24	4	In Failure	10:00	24	20.1	28.9	18.9	10.0	4.1	330	162	0.55	0.32	1,342	1,627	5.52	3.21						90	477	759	2.14	0.07	1,940	7,623	21.49	0.70									
6	24	4	1" Media Replaced	12:30-13:30	0	20.1	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00	17	5,550	6,729	22.85	13.29	90	477	759	2.14	0.07	0	0	0.00	0.00	8,022	31,529	88.9	2.9	18.7	69.2	21.3	25.7	457.1
6	24	5	In Failure	10:00	23	20.6	28.4		28.4	11.5	330	162	0.55	0.32	3,798	4,605	15.64	9.10						90	477	759	2.14	0.07	5,490	21,577	60.84	1.99									
6	24	5	3" Media Replaced	9:15-9:45	0	20.6	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00	12	3,798	4,605	15.64	9.10	90	477	759	2.14	0.07	0	0	0.00	0.00	5,490	21,577	60.8	2.0	12.8	69.2	21.3	25.7	457.1
6	24	6	Running	10:00	23.5	20.6	29.0		29.0	11.8	330	162	0.55	0.32	3,881	4,705	15.98	9.29						90	477	759	2.14	0.07	5,609	22,046	62.16	2.03									
6	24	7	Running/end run	10:00	24	20.3	29.2		29.2	11.8	330	162	0.55	0.32	3,905	4,736	16.08	9.35	24	7,786	9,441	32.05	18.65	90	477	759	2.14	0.07	5,645	22,187	62.56	2.05	11,254	44,233	124.7	4.1					
								Sum =	1,261	511			Project totals =		151,573	183,412	424	151	511	151,573	183,412	424	151						243,607	957,438	2,699	88.3	243,607	957,438	2,699	88.3					

Table B-8. 4-Inch Scale Filter Column Loading Calculations, Column 7, Activated Alumina (new 14x28)

(New Alternate Mesh DD-2 AA, 14x28)

Column Status and Filtration Volumes											Average Clarifier Concentration				Calculated Load				Calculated Load at Failure/Activity					"Typical" Tahoe Storm Water Concentrations					Calculated "Typical" Tahoe Load				Calculated "Tahoe" Load at Failure/Activity				Percent of "Typical" Tahoe Storm Water Treated				
Col	Run #	Run Day	Status/Activity	Time	Hours In-Service (hrs)	Average Flowrate (ml/min)	Calc Vol. Filtered (L)	Overflow Adjust (L)	**Volume Filtered (L)**	**Feet Filtered (ft)**	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Total Filter Load (ft)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (ft)	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (% of annual)	Turb (%)	TSS (%)	Tot-P (%)	Dis-P (%)
7	18	0	Column Start-up	8:20	0	0.0	0.0		0.0	0.0	106	44	0.10	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
7	18	1	Running	8:20	24	20.3	29.2		29.2	11.8	106	44	0.10	0.015	1,254	1,286	2.92	0.44						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
7	18	2	Running	8:20	24	20.2	29.1		29.1	11.8	106	44	0.10	0.015	1,248	1,280	2.91	0.44						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
7	18	3	Running	8:20	24	20.3	29.2		29.2	11.8	106	44	0.10	0.015	1,254	1,286	2.92	0.44						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
7	18	4	Running	8:20	24	19.9	28.7		28.7	11.6	106	44	0.10	0.015	1,230	1,261	2.87	0.43						90	477	759	2.14	0.07	5,534	21,750	61.32	2.01									
7	18	5	Running	8:20	24	19.7	28.4		28.4	11.5	106	44	0.10	0.015	1,217	1,248	2.84	0.43						90	477	759	2.14	0.07	5,478	21,531	60.71	1.99									
7	18	6	Running	8:20	24	21.1	30.4		30.4	12.3	106	44	0.10	0.015	1,304	1,337	3.04	0.46						90	477	759	2.14	0.07	5,868	23,061	65.02	2.13									
7	18	7	Running	8:20	24	21.4	30.8		30.8	12.5	106	44	0.10	0.015	1,322	1,356	3.08	0.46						90	477	759	2.14	0.07	5,951	23,389	65.95	2.16									
7	18	8	Running/end run	8:15	24	21.3	30.7		30.7	12.4	106	44	0.10	0.015	1,316	1,350	3.07	0.46						90	477	759	2.14	0.07	5,923	23,280	65.64	2.15									
7	19	0	Sand Cap Replaced	10:00-11:00	--	--	--		--										96	10,147	10,404	23.64	3.55										45,662	179,464	506.0	16.6	106.4	22.2	5.8	4.7	21.4
7	19	0	Column Start-up	12:00	0	0.0	0.0		0.0	0.0	591	272	0.24	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
7	19	1	Running	12:00	24	20.8	30.0		30.0	12.1	591	272	0.24	0.015	7,167	8,147	7.19	0.45						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
7	19	2	Running	12:00	24	20.4	29.4		29.4	11.9	591	272	0.24	0.015	7,029	7,990	7.05	0.44						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
7	19	3	Running	12:00	24	20.9	30.1		30.1	12.2	591	272	0.24	0.015	7,201	8,186	7.22	0.45						90	477	759	2.14	0.07	5,812	22,843	64.41	2.11									
7	19	4	Running/end run	13:30	25.5	21.3	32.6		32.6	13.2	591	272	0.24	0.015	7,798	8,864	7.82	0.49						90	477	759	2.14	0.07	6,294	24,735	69.74	2.28									
7	20	0	Column Start-up	8:30	0	0.0	0.0		0.0	0.0	627	280	0.58	0.04	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
7	20	1	Running	8:30	24	20.4	29.4		29.4	11.9	627	280	0.58	0.04	7,457	8,225	17.04	1.18						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
7	20	2	Running	8:30	24	19.9	28.7		28.7	11.6	627	280	0.58	0.04	7,274	8,024	16.62	1.15						90	477	759	2.14	0.07	5,534	21,750	61.32	2.01									
7	20	3	Running	8:30	24	20.6	29.7		29.7	12.0	627	280	0.58	0.04	7,530	8,306	17.21	1.19						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
7	20	4	Running	8:30	24	20.6	29.7		29.7	12.0	627	280	0.58	0.04	7,530	8,306	17.21	1.19						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
7	20	5	Running	8:30	24	20.3	29.2		29.2	11.8	627	280	0.58	0.04	7,420	8,185	16.95	1.17						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
7	20	6	Running/end run	9:00	24.5	20.3	29.8		29.8	12.1	627	280	0.58	0.04	7,575	8,355	17.31	1.19						90	477	759	2.14	0.07	5,763	22,649	63.86	2.09									
7	21	0	Column Start-up	9:00	0	0.0	0.0		0.0	0.0	156	85	0.30	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
7	21	1	Running	9:00	24	19.5	28.1		28.1	11.4	156	85	0.30	0.015	1,773	2,387	8.42	0.42						90	477	759	2.14	0.07	5,423	21,313	60.09	1.97									
7	21	2	In Failure	8:30	23.5	20.7	29.2	1.0	28.2	11.4	156	85	0.30	0.015	1,783	2,400	8.47	0.42						90	477	759	2.14	0.07	5,453	21,432	60.43	1.98									
7	21	3	In Failure	9:00	24.5	20.7	30.4	2.8	27.6	11.2	156	85	0.30	0.015	1,745	2,348	8.29	0.41						90	477	759	2.14	0.07	5,336	20,970	59.13	1.93									
7	21	3	Sand Cap Replaced	3:30-4:30	0	20.7	0.0		0.0	0.0	156	85	0.30	0.015	0	0	0.00	0.00	155	79,283	89,724	156.80	10.15	90	477	759	2.14	0.07	0	0	0.00	0.00	73,847	290,236	818.3	26.8	172.0	107.4	30.9	19.2	37.9
7	21	4	Running	9:00	23	20.2	27.9		27.9	11.3	156	85	0.30	0.015	1,761	2,369	8.36	0.42						90	477	759	2.14	0.07	5,383	21,158	59.65	1.95									
7	21	5	Running	9:00	24	20.0	28.8		28.8	11.7	156	85	0.30	0.015	1,819	2,448	8.64	0.43						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
7	21	6	Running/end run	10:00	25	20.3	30.5		30.5	12.3	156	85	0.30	0.015	1,923	2,588	9.14	0.46						90	477	759	2.14	0.07	5,880	23,112	65.16	2.13									
7	22	0	Column Start-up	8:00	0	0.0	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
7	22	1	Running	8:00	24	20.3	29.2		29.2	11.8	266	134	0.32	0.14	3,148	3,917	9.35	4.09						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
7	22	2	Running	8:00	24	20.3	29.2		29.2	11.8	266	134	0.32	0.14	3,148	3,917	9.35	4.09						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
7	22	3	Running	8:00	24	20.5	29.5		29.5	12.0	266	134	0.32	0.14	3,179	3,956	9.45	4.13						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
7	22	4	Running	8:00	24	20.6	29.7		29.7	12.0	266	134	0.32	0.14	3,195	3,975	9.49	4.15						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
7	22	5	Running	8:00	24	20.4	29.4		29.4	11.9	266	134	0.32	0.14	3,164	3,936	9.40	4.11						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
7	22	6	Running	8:00	24	20.5	29.5		29.5	12.0	266	134	0.32	0.14	3,179	3,956	9.45	4.13						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
7	22	7	Running/end run	8:30	24.5	20.3	29.8		29.8	12.1	266	134	0.32	0.14	3,214	3,999	9.55	4.18						90	477	759	2.14	0.07	5,763	22,649	63.86	2.09									
7	23	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	198	128	0.34	0.28	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
7	23	1	Running	10:00	24	20.9	30.1		30.1	12.2	198	128	0.34	0.28	2,413	3,852	10.23	8.43						90	477	759	2.14	0.07	5,812	22,843	64.41	2.11									
7	23	2	Running	10:00	24	20.5	29.5		29.5	12.0	198	128	0.34	0.28	2,366	3,779	10.04	8.27						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
7	23	3	Running	10:00	24	20.2	29.1		29.1	11.8	198	128	0.34	0.28	2,332	3,723	9.89	8.14						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
7	23	4	Running	10:00	24	20.2	29.1		29.1	11.8	198	128	0.34	0.28	2,332	3,723	9.89	8.14						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
7	23	5	Running	10:00	24	20.2	29.1		29.1	11.8	198	128	0.34	0.28	2,332	3,723	9.89	8.14						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
7	23	6	Running	10:00	24	20.1	28.9		28.9	11.7	198	128	0.34	0.28	2,320	3,705	9.84	8.10						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
7	23	7	In Failure	10:00	24	20.0	28.8	1.0	27.9	11.3	198	128	0.34	0.28	2,233	3,565	9.47	7.80						90	477	759	2.14	0.07	5,378	21,138	59.60	1.95									
7	24	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
7	24	1	In Failure	10:00	24	20.5	29.5	22.7	6.8	2.8	330	162	0.55	0.32	911	1,105	3.75	2.18						90	477	759	2.14	0.07	1,317	5,176	14.59	0.48									
7	24	1	Sand Cap Replaced	14:15-14:45	0	20.5	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00	204	44,967	62,236	165.18	89.41	90	477	759	2.14	0.07	0	0	0.00	0.00	97,332	382,540	1078.6	35.3	226.7	46.2	16.3	15.3	253.4
7	24	2	Running	10:00	23.5	20.2	28.5		28.5	11.5	330	162	0.55	0.32	3,805	4,614	15.67	9.11						90	477	759	2.14	0.07	5,500	21,618	60.95	1.99									
7	24	3	Running	10:00	24	20.3	29.2		29.2	11.8	330	162	0.55	0.32	3,905	4,736	16.08	9.35						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
7	24	4	Running	10:00	24	20.5	29.5		29.5	12.0	330	162	0.55	0.32	3,944	4,782	16.24	9.45						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
7	24	5	Running	10:00	24	20.4	29.4		29.4	11.9	330	162	0.55	0.32	3,925	4,759	16.16	9.40						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
7	24	6	Running	10:00	24	20.3	29.2		29.2	11.8	330	162	0.55	0.32	3,905	4,736	16.08	9.35		project end				90	477	759	2.14	0.07	5,645	22,187	62.56	2.05		project end							
7	24	7	Running/end run	10:00	24	20.0	28.8		28.8	11.7	330	162	0.55	0.32	3,848	4,666	15.84	9.22	71	23,333	28,292	96.05	55.89	90	477	759	2.14	0.07	5,562	21,859	61.63	2.02	33,726	132,553	373.7	12.2	78.6	69.2	21.3	25.7	457.1
								Sum =	1,297	525				Project totals =	157,730	190,656	442	159	525	157,730	190,656	442	159						250,567	984,793	2,777	90.8	250,567	984,793	2,777	90.8					

Table B-9. 4-Inch Scale Filter Column Loading Calculations, Column 8, Activated Alumina (new 14x28)

(New Alternate Mesh DD-2 AA, 14x28)

Column Status and Filtration Volumes											Average Clarifier Concentration				Calculated Load				Calculated Load at Failure/Activity					"Typical" Tahoe Storm Water Concentrations					Calculated "Typical" Tahoe Load				Calculated "Tahoe" Load at Failure/Activity				Percent of "Typical" Tahoe Storm Water Treated				
Col	Run #	Run Day	Status/Activity	Time	Hours In-Service (hrs)	Average Flowrate (ml/min)	Calc Vol. Filtered (L)	Overflow Adjust (L)	**Volume Filtered (L)**	**Feet Filtered (ft)**	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Total Filter Load (ft)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (ft)	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (% of annual)	Turb (%)	TSS (%)	Tot-P (%)	Dis-P (%)
8	18	0	Column Start-up	8:20	0	0.0	0.0		0.0	0.0	106	44	0.10	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
8	18	1	Running	8:20	24	20.0	28.8		28.8	11.7	106	44	0.10	0.015	1,236	1,267	2.88	0.43						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
8	18	2	Running	8:20	24	19.5	28.1		28.1	11.4	106	44	0.10	0.015	1,205	1,236	2.81	0.42						90	477	759	2.14	0.07	5,423	21,313	60.09	1.97									
8	18	3	Running	8:20	24	20.4	29.4		29.4	11.9	106	44	0.10	0.015	1,261	1,293	2.94	0.44						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
8	18	4	Running	8:20	24	20.4	29.4		29.4	11.9	106	44	0.10	0.015	1,261	1,293	2.94	0.44						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
8	18	5	Running	8:20	24	19.6	28.2		28.2	11.4	106	44	0.10	0.015	1,211	1,242	2.82	0.42						90	477	759	2.14	0.07	5,451	21,422	60.40	1.98									
8	18	6	Running	8:20	24	20.9	30.1		30.1	12.2	106	44	0.10	0.015	1,292	1,324	3.01	0.45						90	477	759	2.14	0.07	5,812	22,843	64.41	2.11									
8	18	7	Running	8:20	24	20.6	29.7		29.7	12.0	106	44	0.10	0.015	1,273	1,305	2.97	0.44						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
8	18	8	Running/end run	8:15	24	20.1	28.9		28.9	11.7	106	44	0.10	0.015	1,242	1,274	2.89	0.43						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
8	19	0	Column Start-up	12:00	0	0.0	0.0		0.0	0.0	591	272	0.24	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
8	19	1	Running	12:00	24	20.2	29.1		29.1	11.8	591	272	0.24	0.015	6,960	7,912	6.98	0.44						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
8	19	2	In Failure	12:00	24	20.5	29.5	0.8	28.7	11.6	591	272	0.24	0.015	6,872	7,812	6.89	0.43						90	477	759	2.14	0.07	5,546	21,798	61.46	2.01									
8	19	2	Sand Cap Replaced	12:30-13:00	0	20.5	0.0		0.0	0.0	591	272	0.24	0.015	0	0	0.00	0.00	118	23,812	25,956	37.13	4.36	90	477	759	2.14	0.07	0	0	0.00	0.00	56,075	220,389	621.4	20.3	130.6	42.5	11.8	6.0	21.4
8	19	3	Running	12:00	23.5	21.0	29.6		29.6	12.0	591	272	0.24	0.015	7,085	8,054	7.11	0.44						90	477	759	2.14	0.07	5,718	22,474	63.37	2.07									
8	19	4	Running/end run	13:30	25.5	21.3	32.6		32.6	13.2	591	272	0.24	0.015	7,798	8,864	7.82	0.49						90	477	759	2.14	0.07	6,294	24,735	69.74	2.28									
8	20	0	Column Start-up	8:30	0	0.0	0.0		0.0	0.0	627	280	0.58	0.04	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
8	20	1	Running	8:30	24	20.6	29.7		29.7	12.0	627	280	0.58	0.04	7,530	8,306	17.21	1.19						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
8	20	2	Running	8:30	24	20.0	28.8		28.8	11.7	627	280	0.58	0.04	7,311	8,064	16.70	1.15						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
8	20	3	Running	8:30	24	20.6	29.7		29.7	12.0	627	280	0.58	0.04	7,530	8,306	17.21	1.19						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
8	20	4	Running	8:30	24	20.5	29.5		29.5	12.0	627	280	0.58	0.04	7,494	8,266	17.12	1.18						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
8	20	5	Running	8:30	24	20.0	28.8		28.8	11.7	627	280	0.58	0.04	7,311	8,064	16.70	1.15						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
8	20	6	Running/end run	9:00	24.5	20.0	29.4		29.4	11.9	627	280	0.58	0.04	7,463	8,232	17.05	1.18						90	477	759	2.14	0.07	5,678	22,315	62.92	2.06									
8	21	0	Column Start-up	9:00	0	0.0	0.0		0.0	0.0	156	85	0.30	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
8	21	1	Running	9:00	24	19.3	27.8		27.8	11.3	156	85	0.30	0.015	1,755	2,362	8.34	0.42						90	477	759	2.14	0.07	5,367	21,094	59.47	1.95									
8	21	2	Running	9:00	24	20.1	28.9		28.9	11.7	156	85	0.30	0.015	1,828	2,460	8.68	0.43						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
8	21	3	Running	9:00	24	20.8	30.0		30.0	12.1	156	85	0.30	0.015	1,892	2,546	8.99	0.45						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
8	21	4	Running	9:00	24	20.5	29.5		29.5	12.0	156	85	0.30	0.015	1,864	2,509	8.86	0.44						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
8	21	5	Running	9:00	24	20.1	28.9		28.9	11.7	156	85	0.30	0.015	1,828	2,460	8.68	0.43						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
8	21	6	Running/end run	10:00	25	20.0	30.0		30.0	12.1	156	85	0.30	0.015	1,895	2,550	9.00	0.45						90	477	759	2.14	0.07	5,794	22,770	64.20	2.10									
																0	0.00	0.00																							
8	22	0	Column Start-up	8:00	0	0.0	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
8	22	1	Running	8:00	24	20.6	29.7		29.7	12.0	266	134	0.32	0.14	3,195	3,975	9.49	4.15						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
8	22	2	Running	8:00	24	20.6	29.7		29.7	12.0	266	134	0.32	0.14	3,195	3,975	9.49	4.15						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
8	22	3	Running	8:00	24	20.8	30.0		30.0	12.1	266	134	0.32	0.14	3,226	4,014	9.58	4.19						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
8	22	4	Running	8:00	24	20.9	30.1		30.1	12.2	266	134	0.32	0.14	3,241	4,033	9.63	4.21						90	477	759	2.14	0.07	5,812	22,843	64.41	2.11									
8	22	5	Running	8:00	24	20.8	30.0		30.0	12.1	266	134	0.32	0.14	3,226	4,014	9.58	4.19						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
8	22	6	Running	8:00	24	20.8	30.0		30.0	12.1	266	134	0.32	0.14	3,226	4,014	9.58	4.19						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
8	22	7	Running/end run	8:30	24.5	20.6	30.3		30.3	12.3	266	134	0.32	0.14	3,261	4,058	9.69	4.24						90	477	759	2.14	0.07	5,848	22,984	64.80	2.12									
8	23	0	Sand Cap Replaced	9:00-10:00	--	--	--		--		198	128	0.34	0.28					252	93,151	109,125	236.53	39.93	90	477	759	2.14	0.07					120,266	472,676	1332.7	43.6	280.1	77.5	23.1	17.7	91.6
8	23	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	198	128	0.34	0.28	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
8	23	1	Running	10:00	24	21.2	30.5		30.5	12.4	198	128	0.34	0.28	2,447	3,908	10.38	8.55						90	477	759	2.14	0.07	5,895	23,171	65.33	2.14									
8	23	2	Running	10:00	24	20.9	30.1		30.1	12.2	198	128	0.34	0.28	2,413	3,852	10.23	8.43						90	477	759	2.14	0.07	5,812	22,843	64.41	2.11									
8	23	3	Running	10:00	24	20.5	29.5		29.5	12.0	198	128	0.34	0.28	2,366	3,779	10.04	8.27						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
8	23	4	Running	10:00	24	20.3	29.2		29.2	11.8	198	128	0.34	0.28	2,343	3,742	9.94	8.18						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
8	23	5	Running	10:00	24	20.3	29.2		29.2	11.8	198	128	0.34	0.28	2,343	3,742	9.94	8.18						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
8	23	6	Running	10:00	24	20.3	29.2		29.2	11.8	198	128	0.34	0.28	2,343	3,742	9.94	8.18						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
8	23	7	Running/end run	10:00	24	20.3	29.2		29.2	11.8	198	128	0.34	0.28	2,343	3,742	9.94	8.18						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
8	24	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
8	24	1	Running	10:00	24	20.1	28.9		28.9	11.7	330	162	0.55	0.32	3,867	4,689	15.92	9.26						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
8	24	2	Running	10:00	24	20.2	29.1		29.1	11.8	330	162	0.55	0.32	3,886	4,712	16.00	9.31						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
8	24	3	Running	10:00	24	20.0	28.8		28.8	11.7	330	162	0.55	0.32	3,848	4,666	15.84	9.22						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
8	24	4	Running	10:00	24	20.0	28.8		28.8	11.7	330	162	0.55	0.32	3,848	4,666	15.84	9.22						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
8	24	5	Running	10:00	24	20.3	29.2		29.2	11.8	330	162	0.55	0.32	3,905	4,736	16.08	9.35						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
8	24	6	Running	10:00	24	20.3	29.2		29.2	11.8	330	162	0.55	0.32	3,905	4,736	16.08	9.35		project end				90	477	759	2.14	0.07	5,645	22,187	62.56	2.05		project end							
8	24	7	Running/end run	10:00	24	20.0	28.8		28.8	11.7	330	162	0.55	0.32	3,848	4,666	15.84	9.22	166	43,707	59,374	182.00	122.91	90	477	759	2.14	0.07	5,562	21,859	61.63	2.02	79,172	311,166	877.3	28.7	0.0	0.0	0.0	0.0	0.0
								Sum =	1,323	536			Project totals =		160,670	194,456	456	167	536	160,670	194,456	456	167						255,513	1,004,231	2,831	92.6	255,513	1,004,231	2,831	92.6					

Table B-10. 4-Inch Scale Filter Column Loading Calculations, Column 9, Superior 30 Sand

Superior 30

Column Status and Filtration Volumes											Average Clarifier Concentration				Calculated Load				Calculated Load at Failure/Activity					"Typical" Tahoe Storm Water Concentrations					Calculated "Typical" Tahoe Load				Calculated "Tahoe" Load at Failure/Activity				Percent of "Typical" Tahoe Storm Water Treated				
Col	Run #	Run Day	Status/Activity	Time	Hours In-Service (hrs)	Average Flowrate (ml/min)	Calc Vol. Filtered (L)	Overflow Adjust (L)	**Volume Filtered (L)**	**Feet Filtered (ft)**	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Total Filter Load (ft)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (ft)	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (% of annual)	Turb (%)	TSS (%)	Tot-P (%)	Dis-P (%)
9	18	0	Column Start-up	8:20	0	0.0	0.0		0.0	0.0	106	44	0.10	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
9	18	1	Running	8:20	24	20.1	28.9		28.9	11.7	106	44	0.10	0.015	1,242	1,274	2.89	0.43						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
9	18	2	Running	8:20	24	20.5	29.5		29.5	12.0	106	44	0.10	0.015	1,267	1,299	2.95	0.44						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
9	18	3	Running	8:20	24	20.7	29.8		29.8	12.1	106	44	0.10	0.015	1,279	1,312	2.98	0.45						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
9	18	4	Running	8:20	24	20.7	29.8		29.8	12.1	106	44	0.10	0.015	1,279	1,312	2.98	0.45						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
9	18	5	Running	8:20	24	20.2	29.1		29.1	11.8	106	44	0.10	0.015	1,248	1,280	2.91	0.44						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
9	18	6	In Failure	8:20	24	21.2	30.5		30.5	12.4	106	44	0.10	0.015	1,310	1,343	3.05	0.46						90	477	759	2.14	0.07	5,895	23,171	65.33	2.14									
9	18	6	Sand Cap Replaced	9:00-10:00	0	21.2	0.0		0.0	0.0	106	44	0.10	0.015	0	0	0.00	0.00	72	7,626	7,819	17.77	2.67	90	477	759	2.14	0.07	0	0	0.00	0.00	34,316	134,871	380.3	12.4	79.9	22.2	5.8	4.7	21.4
9	18	7	Running	8:20	23	20.6	28.4		28.4	11.5	106	44	0.10	0.015	1,220	1,251	2.84	0.43						90	477	759	2.14	0.07	5,490	21,577	60.84	1.99									
9	18	8	Running/end run	8:15	24	20.7	29.8		29.8	12.1	106	44	0.10	0.015	1,279	1,312	2.98	0.45						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
9	19	0	Column Start-up	12:00	0	0.0	0.0		0.0	0.0	591	272	0.24	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
9	19	1	Running	12:00	24	20.5	29.5		29.5	12.0	591	272	0.24	0.015	7,063	8,029	7.08	0.44						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
9	19	2	Running	12:00	24	20.3	29.2		29.2	11.8	591	272	0.24	0.015	6,994	7,951	7.02	0.44						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
9	19	3	Running	12:00	24	20.7	29.8		29.8	12.1	591	272	0.24	0.015	7,132	8,108	7.15	0.45						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
9	19	4	Running/end run	13:30	25.5	21.0	32.1		32.1	13.0	591	272	0.24	0.015	7,688	8,739	7.71	0.48						90	477	759	2.14	0.07	6,205	24,387	68.76	2.25									
9	20	0	Column Start-up	8:30	0	0.0	0.0		0.0	0.0	627	280	0.58	0.04	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
9	20	1	Running	8:30	24	20.9	30.1		30.1	12.2	627	280	0.58	0.04	7,640	8,427	17.46	1.20						90	477	759	2.14	0.07	5,812	22,843	64.41	2.11									
9	20	2	Running	8:30	24	20.0	28.8		28.8	11.7	627	280	0.58	0.04	7,311	8,064	16.70	1.15						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
9	20	3	Running	8:30	24	20.1	28.9		28.9	11.7	627	280	0.58	0.04	7,347	8,104	16.79	1.16						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
9	20	4	Running	8:30	24	20.1	28.9		28.9	11.7	627	280	0.58	0.04	7,347	8,104	16.79	1.16						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
9	20	5	In Failure	8:30	24	20.0	28.8	2.8	26.0	10.5	627	280	0.58	0.04	6,600	7,280	15.08	1.04						90	477	759	2.14	0.07	5,021	19,734	55.64	1.82									
9	20	5	Sand Cap Replaced	9:30-11:30	0	20.0	0.0		0.0	0.0	627	280	0.58	0.04	0	0	0.00	0.00	130	67,622	75,370	117.60	8.40	90	477	759	2.14	0.07	0	0	0.00	0.00	62,128	244,178	688.5	22.5	144.7	108.8	30.9	17.1	37.3
9	20	6	Running/end run	9:00	22.5	20.0	27.0		27.0	10.9	627	280	0.58	0.04	6,854	7,560	15.66	1.08						90	477	759	2.14	0.07	5,214	20,493	57.78	1.89									
9	21	0	Column Start-up	9:00	0	0.0	0.0		0.0	0.0	156	85	0.30	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
9	21	1	Running	9:00	24	18.8	27.1		27.1	11.0	156	85	0.30	0.015	1,710	2,301	8.12	0.41						90	477	759	2.14	0.07	5,228	20,548	57.93	1.90									
9	21	2	Running	9:00	24	20.5	29.5		29.5	12.0	156	85	0.30	0.015	1,864	2,509	8.86	0.44						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
9	21	3	Running	9:00	24	20.4	29.4		29.4	11.9	156	85	0.30	0.015	1,855	2,497	8.81	0.44						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
9	21	4	Running	9:00	24	20.8	30.0		30.0	12.1	156	85	0.30	0.015	1,892	2,546	8.99	0.45						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
9	21	5	Running	9:00	24	20.8	30.0		30.0	12.1	156	85	0.30	0.015	1,892	2,546	8.99	0.45						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
9	21	6	Running/end run	10:00	25	20.7	31.1		31.1	12.6	156	85	0.30	0.015	1,961	2,639	9.32	0.47						90	477	759	2.14	0.07	5,996	23,567	66.45	2.17									
9	22	0	Column Start-up	8:00	0	0.0	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
9	22	1	Running	8:00	24	20.6	29.7		29.7	12.0	266	134	0.32	0.14	3,195	3,975	9.49	4.15						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
9	22	2	Running	8:00	24	20.6	29.7		29.7	12.0	266	134	0.32	0.14	3,195	3,975	9.49	4.15						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
9	22	3	In Failure	8:00	24	20.8	30.0		30.0	12.1	266	134	0.32	0.14	3,226	4,014	9.58	4.19						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
9	22	3	Sand Cap Replaced	13:45-14:15	0	20.8	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00	119	27,643	34,562	97.31	16.23	90	477	759	2.14	0.07	0	0	0.00	0.00	56,622	222,540	627.5	20.5	131.9	48.8	15.5	15.5	79.1
9	22	4	Running	8:00	23.5	20.9	29.5		29.5	11.9	266	134	0.32	0.14	3,174	3,949	9.43	4.13						90	477	759	2.14	0.07	5,691	22,367	63.06	2.06									
9	22	5	Running	8:00	24	20.9	30.1		30.1	12.2	266	134	0.32	0.14	3,241	4,033	9.63	4.21						90	477	759	2.14	0.07	5,812	22,843	64.41	2.11									
9	22	6	Running	8:00	24	21.1	30.4		30.4	12.3	266	134	0.32	0.14	3,272	4,071	9.72	4.25						90	477	759	2.14	0.07	5,868	23,061	65.02	2.13									
9	22	7	Running/end run	8:30	24.5	21.3	31.3		31.3	12.7	266	134	0.32	0.14	3,372	4,196	10.02	4.38						90	477	759	2.14	0.07	6,047	23,765	67.01	2.19									
9	23	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	198	128	0.34	0.28	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
9	23	1	Running	10:00	24	20.4	29.4		29.4	11.9	198	128	0.34	0.28	2,355	3,760	9.99	8.23						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
9	23	2	Running	10:00	24	20.5	29.5		29.5	12.0	198	128	0.34	0.28	2,366	3,779	10.04	8.27						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
9	23	3	Running	10:00	24	20.2	29.1		29.1	11.8	198	128	0.34	0.28	2,332	3,723	9.89	8.14						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
9	23	4	Running	10:00	24	20.0	28.8		28.8	11.7	198	128	0.34	0.28	2,309	3,686	9.79	8.06						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
9	23	5	Running	10:00	24	20.1	28.9		28.9	11.7	198	128	0.34	0.28	2,320	3,705	9.84	8.10						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
9	23	6	Running	10:00	24	20.2	29.1		29.1	11.8	198	128	0.34	0.28	2,332	3,723	9.89	8.14						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
9	23	7	Running/end run	10:00	24	20.3	29.2		29.2	11.8	198	128	0.34	0.28	2,343	3,742	9.94	8.18						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
9	24	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
9	24	1	Running	10:00	24	20.4	29.4		29.4	11.9	330	162	0.55	0.32	3,925	4,759	16.16	9.40						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
9	24	2	Running	10:00	24	20.4	29.4		29.4	11.9	330	162	0.55	0.32	3,925	4,759	16.16	9.40						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
9	24	3	Running	10:00	24	20.0	28.8		28.8	11.7	330	162	0.55	0.32	3,848	4,666	15.84	9.22						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
9	24	4	Running	10:00	24	20.0	28.8		28.8	11.7	330	162	0.55	0.32	3,848	4,666	15.84	9.22						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
9	24	5	Running	10:00	24	20.1	28.9		28.9	11.7	330	162	0.55	0.32	3,867	4,689	15.92	9.26						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
9	24	6	Running	10:00	24	20.3	29.2		29.2	11.8	330	162	0.55	0.32	3,905	4,736	16.08	9.35		project end				90	477	759	2.14	0.07	5,645	22,187	62.56	2.05		project end							
9	24	7	Running/end run	10:00	24	20.3	29.2		29.2	11.8	330	162	0.55	0.32	3,905	4,736	16.08	9.35	214	56,639	75,376	220.25	139.31	90	477	759	2.14	0.07	5,645	22,187	62.56	2.05	102,172	401,563	1132.2	37.0	238.0	55.4	18.8	19.5	376.2
								Sum =	1,322	535			Project totals =		159,529	193,126	453	167	535	159,529	193,126	453	167						255,239	1,003,152	2,828	92.5	255,239	1,003,152	2,828	92.5					

Table B-11. 4-Inch Scale Filter Column Loading Calculations, Column 10, Superior 30 Sand

Superior 30 / Column Status and Filtration Volumes											Average Clarifier Concentration				Calculated Load				Calculated Load at Failure/Activity					"Typical" Tahoe Storm Water Concentrations					Calculated "Typical" Tahoe Load				Calculated "Tahoe" Load at Failure/Activity				Percent of "Typical" Tahoe Storm Water Treated				
Col	Run #	Run Day	Status/Activity	Time	Hours In-Service (hrs)	Average Flowrate (ml/min)	Calc Vol. Filtered (L)	Overflow Adjust (L)	**Volume Filtered (L)**	**Feet Filtered (ft)**	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Total Filter Load (ft)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (ft)	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (% of annual)	Turb (%)	TSS (%)	Tot-P (%)	Dis-P (%)
10	18	0	Column Start-up	8:20	0	0.0	0.0		0.0	0.0	106	44	0.10	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
10	18	1	Running	8:20	24	20.7	29.8		29.8	12.1	106	44	0.10	0.015	1,279	1,312	2.98	0.45						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
10	18	2	Running	8:20	24	19.7	28.4		28.4	11.5	106	44	0.10	0.015	1,217	1,248	2.84	0.43						90	477	759	2.14	0.07	5,478	21,531	60.71	1.99									
10	18	3	Running	8:20	24	20.0	28.8		28.8	11.7	106	44	0.10	0.015	1,236	1,267	2.88	0.43						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
10	18	4	Running	8:20	24	19.6	28.2		28.2	11.4	106	44	0.10	0.015	1,211	1,242	2.82	0.42						90	477	759	2.14	0.07	5,451	21,422	60.40	1.98									
10	18	5	Running	8:20	24	19.3	27.8		27.8	11.3	106	44	0.10	0.015	1,193	1,223	2.78	0.42						90	477	759	2.14	0.07	5,367	21,094	59.47	1.95									
10	18	6	In Failure	8:20	24	20.6	29.7		29.7	12.0	106	44	0.10	0.015	1,273	1,305	2.97	0.44						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
10	18	6	Sand Cap Replaced	9:00-10:00	0	20.6	0.0		0.0	0.0	106	44	0.10	0.015	0	0	0.00	0.00	70	7,410	7,597	17.27	2.59	90	477	759	2.14	0.07	0	0	0.00	0.00	33,343	131,046	369.5	12.1	77.7	22.2	5.8	4.7	21.4
10	18	7	Running	8:20	23	20.2	27.9		27.9	11.3	106	44	0.10	0.015	1,196	1,227	2.79	0.42						90	477	759	2.14	0.07	5,383	21,158	59.65	1.95									
10	18	8	Running/end run	8:15	24	21.0	30.2		30.2	12.2	106	44	0.10	0.015	1,298	1,331	3.02	0.45						90	477	759	2.14	0.07	5,840	22,952	64.71	2.12									
10	19	0	Column Start-up	12:00	0	0.0	0.0		0.0	0.0	591	272	0.24	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
10	19	1	Running	12:00	24	20.9	30.1		30.1	12.2	591	272	0.24	0.015	7,201	8,186	7.22	0.45						90	477	759	2.14	0.07	5,812	22,843	64.41	2.11									
10	19	2	Running	12:00	24	20.4	29.4		29.4	11.9	591	272	0.24	0.015	7,029	7,990	7.05	0.44						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
10	19	3	Running	12:00	24	20.9	30.1		30.1	12.2	591	272	0.24	0.015	7,201	8,186	7.22	0.45						90	477	759	2.14	0.07	5,812	22,843	64.41	2.11									
10	19	4	Running/end run	13:30	25.5	21.3	32.6		32.6	13.2	591	272	0.24	0.015	7,798	8,864	7.82	0.49						90	477	759	2.14	0.07	6,294	24,735	69.74	2.28									
10	20	0	Column Start-up	8:30	0	0.0	0.0		0.0	0.0	627	280	0.58	0.04	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
10	20	1	Running	8:30	24	19.9	28.7		28.7	11.6	627	280	0.58	0.04	7,274	8,024	16.62	1.15						90	477	759	2.14	0.07	5,534	21,750	61.32	2.01									
10	20	2	Running	8:30	24	20.0	28.8		28.8	11.7	627	280	0.58	0.04	7,311	8,064	16.70	1.15						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
10	20	3	Running	8:30	24	19.9	28.7		28.7	11.6	627	280	0.58	0.04	7,274	8,024	16.62	1.15						90	477	759	2.14	0.07	5,534	21,750	61.32	2.01									
10	20	4	Running	8:30	24	20.6	29.7		29.7	12.0	627	280	0.58	0.04	7,530	8,306	17.21	1.19						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
10	20	5	In Failure	8:30	24	21.0	30.2	1.0	29.3	11.9	627	280	0.58	0.04	7,435	8,201	16.99	1.17						90	477	759	2.14	0.07	5,656	22,231	62.68	2.05									
10	20	5	Sand Cap Replaced	9:30-11:30	0	21.0	0.0		0.0	0.0	627	280	0.58	0.04	0	0	0.00	0.00	132	68,547	76,402	119.27	8.51	90	477	759	2.14	0.07	0	0	0.00	0.00	62,829	246,932	696.2	22.8	146.4	109.1	30.9	17.1	37.4
10	20	6	Running/end run	9:00	22.5	21.0	28.4		28.4	11.5	627	280	0.58	0.04	7,197	7,938	16.44	1.13						90	477	759	2.14	0.07	5,475	21,518	60.67	1.98									
10	21	0	Column Start-up	9:00	0	0.0	0.0		0.0	0.0	156	85	0.30	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
10	21	1	Running	9:00	24	21.0	30.2		30.2	12.2	156	85	0.30	0.015	1,910	2,570	9.07	0.45						90	477	759	2.14	0.07	5,840	22,952	64.71	2.12									
10	21	2	Running	9:00	24	20.9	30.1		30.1	12.2	156	85	0.30	0.015	1,901	2,558	9.03	0.45						90	477	759	2.14	0.07	5,812	22,843	64.41	2.11									
10	21	3	Running	9:00	24	20.4	29.4		29.4	11.9	156	85	0.30	0.015	1,855	2,497	8.81	0.44						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
10	21	4	Running	9:00	24	20.8	30.0		30.0	12.1	156	85	0.30	0.015	1,892	2,546	8.99	0.45						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
10	21	5	Running	9:00	24	20.3	29.2		29.2	11.8	156	85	0.30	0.015	1,846	2,485	8.77	0.44						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
10	21	6	Running/end run	10:00	25	21.0	31.5		31.5	12.8	156	85	0.30	0.015	1,989	2,678	9.45	0.47						90	477	759	2.14	0.07	6,083	23,909	67.41	2.21									
10	22	0	Column Start-up	8:00	0	0.0	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
10	22	0	Sand Cap Replaced	17:30-18:00	0	20.4	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00	85	18,590	23,272	70.56	3.84	90	477	759	2.14	0.07	0	0	0.00	0.00	40,312	158,438	446.7	14.6	93.9	46.1	14.7	15.8	26.3
10	22	1	Running	8:00	23.5	20.4	28.8		28.8	11.6	266	134	0.32	0.14	3,098	3,854	9.20	4.03						90	477	759	2.14	0.07	5,555	21,832	61.55	2.01									
10	22	2	Running	8:00	24	20.6	29.7		29.7	12.0	266	134	0.32	0.14	3,195	3,975	9.49	4.15						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
10	22	3	Running	8:00	24	20.8	30.0		30.0	12.1	266	134	0.32	0.14	3,226	4,014	9.58	4.19						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
10	22	4	Running	8:00	24	20.9	30.1		30.1	12.2	266	134	0.32	0.14	3,241	4,033	9.63	4.21						90	477	759	2.14	0.07	5,812	22,843	64.41	2.11									
10	22	5	Running	8:00	24	20.5	29.5		29.5	12.0	266	134	0.32	0.14	3,179	3,956	9.45	4.13						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
10	22	6	Running	8:00	24	20.5	29.5		29.5	12.0	266	134	0.32	0.14	3,179	3,956	9.45	4.13						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
10	22	7	Running/end run	8:30	24.5	20.6	30.3		30.3	12.3	266	134	0.32	0.14	3,261	4,058	9.69	4.24						90	477	759	2.14	0.07	5,848	22,984	64.80	2.12									
10	23	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	198	128	0.34	0.28	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
10	23	1	Running	10:00	24	20.3	29.2		29.2	11.8	198	128	0.34	0.28	2,343	3,742	9.94	8.18						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
10	23	2	Running	10:00	24	20.2	29.1		29.1	11.8	198	128	0.34	0.28	2,332	3,723	9.89	8.14						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
10	23	3	Running	10:00	24	20.1	28.9		28.9	11.7	198	128	0.34	0.28	2,320	3,705	9.84	8.10						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
10	23	4	Running	10:00	24	20.1	28.9		28.9	11.7	198	128	0.34	0.28	2,320	3,705	9.84	8.10						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
10	23	5	Running	10:00	24	20.0	28.8		28.8	11.7	198	128	0.34	0.28	2,309	3,686	9.79	8.06						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
10	23	6	Running	10:00	24	20.0	28.8		28.8	11.7	198	128	0.34	0.28	2,309	3,686	9.79	8.06						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
10	23	7	Running/end run	10:00	24	20.0	28.8		28.8	11.7	198	128	0.34	0.28	2,309	3,686	9.79	8.06						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
10	24	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
10	24	1	Running	10:00	24	20.7	29.8		29.8	12.1	330	162	0.55	0.32	3,982	4,829	16.39	9.54						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
10	24	2	Running	10:00	24	20.0	28.8		28.8	11.7	330	162	0.55	0.32	3,848	4,666	15.84	9.22						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
10	24	3	Running	10:00	24	20.0	28.8		28.8	11.7	330	162	0.55	0.32	3,848	4,666	15.84	9.22						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
10	24	4	Running	10:00	24	20.1	28.9		28.9	11.7	330	162	0.55	0.32	3,867	4,689	15.92	9.26						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
10	24	5	Running	10:00	24	20.6	29.7		29.7	12.0	330	162	0.55	0.32	3,963	4,806	16.32	9.49						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
10	24	6	Running	10:00	24	20.5	29.5		29.5	12.0	330	162	0.55	0.32	3,944	4,782	16.24	9.45		project end				90	477	759	2.14	0.07	5,701	22,406	63.17	2.07		project end							
10	24	7	Running/end run	10:00	24	20.0	28.8		28.8	11.7	330	162	0.55	0.32	3,848	4,666	15.84	9.22	249	65,920	86,881	247.77	151.21	90	477	759	2.14	0.07	5,562	21,859	61.63	2.02	118,717	466,589	1315.5	43.0	276.5	55.5	18.6	18.8	351.4
								Sum =	1,321	535			Project totals =		160,466	194,152	455	166	535	160,466	194,152	455	166						255,201	1,003,006	2,828	92.5	255,201	1,003,006	2,828	92.5					

Table B-12. 4-Inch Scale Filter Column Loading Calculations, Column 11, Limestone

Limestone

Column Status and Filtration Volumes											Average Clarifier Concentration				Calculated Load				Calculated Load at Failure/Activity					"Typical" Tahoe Storm Water Concentrations					Calculated "Typical" Tahoe Load				Calculated "Tahoe" Load at Failure/Activity				Percent of "Typical" Tahoe Storm Water Treated				
Col	Run #	Run Day	Status/Activity	Time	Hours In-Service (hrs)	Average Flowrate (ml/min)	Calc Vol. Filtered (L)	Overflow Adjust (L)	**Volume Filtered (L)**	**Feet Filtered (ft)**	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Total Filter Load (ft)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (ft)	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (% of annual)	Turb (%)	TSS (%)	Tot-P (%)	Dis-P (%)
11	18	0	Column Start-up	8:20	0	0.0	0.0		0.0	0.0	106	44	0.10	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
11	18	1	Running	8:20	24	21.1	30.4		30.4	12.3	106	44	0.10	0.015	1,304	1,337	3.04	0.46						90	477	759	2.14	0.07	5,868	23,061	65.02	2.13									
11	18	2	Running	8:20	24	20.9	30.1		30.1	12.2	106	44	0.10	0.015	1,292	1,324	3.01	0.45						90	477	759	2.14	0.07	5,812	22,843	64.41	2.11									
11	18	3	Running	8:20	24	20.6	29.7		29.7	12.0	106	44	0.10	0.015	1,273	1,305	2.97	0.44						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
11	18	4	Running	8:20	24	20.0	28.8		28.8	11.7	106	44	0.10	0.015	1,236	1,267	2.88	0.43						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
11	18	5	Running	8:20	24	19.8	28.5		28.5	11.5	106	44	0.10	0.015	1,224	1,255	2.85	0.43						90	477	759	2.14	0.07	5,506	21,641	61.02	2.00									
11	18	6	Running	8:20	24	19.9	28.7		28.7	11.6	106	44	0.10	0.015	1,230	1,261	2.87	0.43						90	477	759	2.14	0.07	5,534	21,750	61.32	2.01									
11	18	7	Running	8:20	24	21.0	30.2		30.2	12.2	106	44	0.10	0.015	1,298	1,331	3.02	0.45						90	477	759	2.14	0.07	5,840	22,952	64.71	2.12									
11	18	8	Running/end run	8:15	24	20.4	29.4		29.4	11.9	106	44	0.10	0.015	1,261	1,293	2.94	0.44						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
11	19	0	Sand Cap Replaced	10:00-11:00	--	--	--		--										95	10,116	10,372	23.57	3.54										45,523	178,918	504.5	16.5	106.0	22.2	5.8	4.7	21.4
11	19	0	Column Start-up	12:00	0	0.0	0.0		0.0	0.0	591	272	0.24	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
11	19	1	Running	12:00	24	20.0	28.8		28.8	11.7	591	272	0.24	0.015	6,891	7,834	6.91	0.43						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
11	19	2	Running	12:00	24	20.0	28.8		28.8	11.7	591	272	0.24	0.015	6,891	7,834	6.91	0.43						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
11	19	3	Running	12:00	24	20.6	29.7		29.7	12.0	591	272	0.24	0.015	7,098	8,069	7.12	0.44						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
11	19	4	Running/end run	13:30	25.5	21.0	32.1		32.1	13.0	591	272	0.24	0.015	7,688	8,739	7.71	0.48						90	477	759	2.14	0.07	6,205	24,387	68.76	2.25									
11	20	0	Column Start-up	8:30	0	0.0	0.0		0.0	0.0	627	280	0.58	0.04	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
11	20	1	Running	8:30	24	20.6	29.7		29.7	12.0	627	280	0.58	0.04	7,530	8,306	17.21	1.19						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
11	20	2	Running	8:30	24	20.3	29.2		29.2	11.8	627	280	0.58	0.04	7,420	8,185	16.95	1.17						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
11	20	3	Running	8:30	24	19.7	28.4		28.4	11.5	627	280	0.58	0.04	7,201	7,943	16.45	1.13						90	477	759	2.14	0.07	5,478	21,531	60.71	1.99									
11	20	4	Running	8:30	24	20.4	29.4		29.4	11.9	627	280	0.58	0.04	7,457	8,225	17.04	1.18						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
11	20	5	Running	8:30	24	21.0	30.2		30.2	12.2	627	280	0.58	0.04	7,676	8,467	17.54	1.21						90	477	759	2.14	0.07	5,840	22,952	64.71	2.12									
11	20	6	Running/end run	9:00	24.5	21.0	30.9		30.9	12.5	627	280	0.58	0.04	7,836	8,644	17.90	1.23						90	477	759	2.14	0.07	5,962	23,430	66.06	2.16									
11	21	0	Column Start-up	9:00	0	0.0	0.0		0.0																																
11	21	1	Running	9:00	24	20.1	28.9		28.9	11.7	156	85	0.30	0.015	1,828	2,460	8.68	0.43						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
11	21	2	Running	9:00	24	20.2	29.1		29.1	11.8	156	85	0.30	0.015	1,837	2,472	8.73	0.44						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
11	21	3	Running	9:00	24	20.0	28.8		28.8	11.7	156	85	0.30	0.015	1,819	2,448	8.64	0.43						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
11	21	4	Running	9:00	24	19.6	28.2		28.2	11.4	156	85	0.30	0.015	1,783	2,399	8.47	0.42						90	477	759	2.14	0.07	5,451	21,422	60.40	1.98									
11	21	5	Running	9:00	24	20.0	28.8		28.8	11.7	156	85	0.30	0.015	1,819	2,448	8.64	0.43						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
11	21	6	Running/end run	10:00	25	20.7	31.1		31.1	12.6	156	85	0.30	0.015	1,961	2,639	9.32	0.47						90	477	759	2.14	0.07	5,996	23,567	66.45	2.17									
11	22	0	Column Start-up	8:00	0	0.0	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
11	22	0	Sand Cap Replaced	16:00-17:00	0	20.9	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00	191	84,735	97,112	184.22	11.52	90	477	759	2.14	0.07	0	0	0.00	0.00	91,161	358,286	1010.2	33.0	212.3	93.0	27.1	18.2	34.9
11	22	1	Running	8:00	23	20.9	28.8		28.8	11.7	266	134	0.32	0.14	3,106	3,865	9.23	4.04						90	477	759	2.14	0.07	5,570	21,891	61.72	2.02									
11	22	2	Running	8:00	24	20.7	29.8		29.8	12.1	266	134	0.32	0.14	3,210	3,994	9.54	4.17						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
11	22	3	Running	8:00	24	20.8	30.0		30.0	12.1	266	134	0.32	0.14	3,226	4,014	9.58	4.19						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
11	22	4	Running	8:00	24	20.9	30.1		30.1	12.2	266	134	0.32	0.14	3,241	4,033	9.63	4.21						90	477	759	2.14	0.07	5,812	22,843	64.41	2.11									
11	22	5	Running	8:00	24	20.7	29.8		29.8	12.1	266	134	0.32	0.14	3,210	3,994	9.54	4.17						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
11	22	6	Running	8:00	24	21.0	30.2		30.2	12.2	266	134	0.32	0.14	3,257	4,052	9.68	4.23						90	477	759	2.14	0.07	5,840	22,952	64.71	2.12									
11	22	7	Running/end run	8:30	24.5	21.0	30.9		30.9	12.5	266	134	0.32	0.14	3,324	4,137	9.88	4.32						90	477	759	2.14	0.07	5,962	23,430	66.06	2.16									
11	23	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	198	128	0.34	0.28	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
11	23	1	Running	10:00	24	20.7	29.8		29.8	12.1	198	128	0.34	0.28	2,389	3,815	10.13	8.35						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
11	23	2	Running	10:00	24	20.8	30.0		30.0	12.1	198	128	0.34	0.28	2,401	3,834	10.18	8.39						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
11	23	3	Running	10:00	24	20.4	29.4		29.4	11.9	198	128	0.34	0.28	2,355	3,760	9.99	8.23						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
11	23	4	Running	10:00	24	20.5	29.5		29.5	12.0	198	128	0.34	0.28	2,366	3,779	10.04	8.27						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
11	23	5	Running	10:00	24	20.3	29.2		29.2	11.8	198	128	0.34	0.28	2,343	3,742	9.94	8.18						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
11	23	6	Running	10:00	24	20.1	28.9		28.9	11.7	198	128	0.34	0.28	2,320	3,705	9.84	8.10						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
11	23	7	Running/end run	10:00	24	20.0	28.8		28.8	11.7	198	128	0.34	0.28	2,309	3,686	9.79	8.06						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
11	24	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
11	24	1	Running	10:00	24	20.8	30.0		30.0	12.1	330	162	0.55	0.32	4,002	4,852	16.47	9.58						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
11	24	2	Running	10:00	24	20.2	29.1		29.1	11.8	330	162	0.55	0.32	3,886	4,712	16.00	9.31						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
11	24	3	Running	10:00	24	20.3	29.2		29.2	11.8	330	162	0.55	0.32	3,905	4,736	16.08	9.35						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
11	24	4	Running	10:00	24	20.8	30.0		30.0	12.1	330	162	0.55	0.32	4,002	4,852	16.47	9.58						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
11	24	5	Running	10:00	24	21.0	30.2		30.2	12.2	330	162	0.55	0.32	4,040	4,899	16.63	9.68						90	477	759	2.14	0.07	5,840	22,952	64.71	2.12									
11	24	6	Running	10:00	24	20.5	29.5		29.5	12.0	330	162	0.55	0.32	3,944	4,782	16.24	9.45						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
11	24	7	Running/end run	10:00	24	20.0	28.8		28.8	11.7	330	162	0.55	0.32	3,848	4,666	15.84	9.22		project end				90	477	759	2.14	0.07	5,562	21,859	61.63	2.02		project end							
																			252	66,685	87,908	250.72	153.09	90	477	759	2.14	0.07	0	0	0.00	0.00	120,125	472,122	1331.1	43.5	279.8	55.5	18.6	18.8	351.6
								SUM =	1,330	538			Project totals =		161,537	195,393	459	168	538	161,537	195,393	459	168						256,809	1,009,326	2,846	93.1	256,809	1,009,326	2,846	93.1					

Table B-13. 4-Inch Scale Filter Column Loading Calculations, Column 12, Limestone

Limestone

Col	Run #	Run Day	Status/Activity	Time	Column Status and Filtration Volumes: Hours In-Service (hrs)	Average Flowrate (ml/min)	Calc Vol. Filtered (L)	Overflow Adjust (L)	**Volume Filtered (L)**	**Feet Filtered (ft)**	Average Clarifier Concentration: Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Calculated Load: Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Calculated Load at Failure/Activity: Total Filter Load (ft)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	"Typical" Tahoe Storm Water Concentrations: Filter Load (ft)	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Calculated "Typical" Tahoe Load: Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Calculated "Tahoe" Load at Failure/Activity: Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Percent of "Typical" Tahoe Storm Water Treated: Filter Load (% of annual)	Turb (%)	TSS (%)	Tot-P (%)	Dis-P (%)
12	18	0	Column Start-up	8:20	0	0.0	0.0		0.0	0.0	106	44	0.10	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
12	18	1	Running	8:20	24	20.7	29.8		29.8	12.1	106	44	0.10	0.015	1,279	1,312	2.98	0.45						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
12	18	2	Running	8:20	24	21.0	30.2		30.2	12.2	106	44	0.10	0.015	1,298	1,331	3.02	0.45						90	477	759	2.14	0.07	5,840	22,952	64.71	2.12									
12	18	3	Running	8:20	24	20.9	30.1		30.1	12.2	106	44	0.10	0.015	1,292	1,324	3.01	0.45						90	477	759	2.14	0.07	5,812	22,843	64.41	2.11									
12	18	4	Running	8:20	24	20.7	29.8		29.8	12.1	106	44	0.10	0.015	1,279	1,312	2.98	0.45						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
12	18	5	Running	8:20	24	20.3	29.2		29.2	11.8	106	44	0.10	0.015	1,254	1,286	2.92	0.44						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
12	18	6	Running	8:20	24	20.0	28.8		28.8	11.7	106	44	0.10	0.015	1,236	1,267	2.88	0.43						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
12	18	7	Running	8:20	24	20.6	29.7		29.7	12.0	106	44	0.10	0.015	1,273	1,305	2.97	0.44						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
12	18	8	In Failure	8:15	24	20.6	29.7	4.3	25.4	10.3	106	44	0.10	0.015	1,088	1,116	2.54	0.38						90	477	759	2.14	0.07	4,898	19,251	54.28	1.78									
12	19	0	Sand Cap Replaced	10:00-11:00	--	--	--		--										94	10,000	10,253	23.30	3.50										44,999	176,856	498.6	16.3	104.8	22.2	5.8	4.7	21.4
12	19	0	Column Start-up	12:00	0	0.0	0.0		0.0	0.0	591	272	0.24	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
12	19	1	Running	12:00	24	21.0	30.2		30.2	12.2	591	272	0.24	0.015	7,236	8,225	7.26	0.45						90	477	759	2.14	0.07	5,840	22,952	64.71	2.12									
12	19	2	Running	12:00	24	21.1	30.4		30.4	12.3	591	272	0.24	0.015	7,270	8,264	7.29	0.46						90	477	759	2.14	0.07	5,868	23,061	65.02	2.13									
12	19	3	Running	12:00	24	21.0	30.2		30.2	12.2	591	272	0.24	0.015	7,236	8,225	7.26	0.45						90	477	759	2.14	0.07	5,840	22,952	64.71	2.12									
12	19	4	Running/end run	13:30	25.5	21.0	32.1		32.1	13.0	591	272	0.24	0.015	7,688	8,739	7.71	0.48						90	477	759	2.14	0.07	6,205	24,387	68.76	2.25									
12	20	0	Column Start-up	8:30	0	0.0	0.0		0.0	0.0	627	280	0.58	0.04	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
12	20	1	Running	8:30	24	20.1	28.9		28.9	11.7	627	280	0.58	0.04	7,347	8,104	16.79	1.16						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
12	20	2	Running	8:30	24	20.0	28.8		28.8	11.7	627	280	0.58	0.04	7,311	8,064	16.70	1.15						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
12	20	3	Running	8:30	24	20.0	28.8		28.8	11.7	627	280	0.58	0.04	7,311	8,064	16.70	1.15						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
12	20	4	Running	8:30	24	20.3	29.2		29.2	11.8	627	280	0.58	0.04	7,420	8,185	16.95	1.17						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
12	20	5	Running	8:30	24	20.0	28.8		28.8	11.7	627	280	0.58	0.04	7,311	8,064	16.70	1.15						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
12	20	6	Running/end run	9:00	24.5	20.0	29.4		29.4	11.9	627	280	0.58	0.04	7,463	8,232	17.05	1.18						90	477	759	2.14	0.07	5,678	22,315	62.92	2.06									
12	21	0	Column Start-up	9:00	0	0.0	0.0		0.0	0.0	156	85	0.30	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
12	21	1	Running	9:00	24	20.8	30.0		30.0	12.1	156	85	0.30	0.015	1,892	2,546	8.99	0.45						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
12	21	2	In Failure	9:00	24	20.9	30.1		30.1	12.2	156	85	0.30	0.015	1,901	2,558	9.03	0.45						90	477	759	2.14	0.07	5,812	22,843	64.41	2.11									
12	21	3	In Failure	9:00	24	21.0	30.2		30.2	12.2	156	85	0.30	0.015	1,910	2,570	9.07	0.45						90	477	759	2.14	0.07	5,840	22,952	64.71	2.12									
12	21	3	Sand Cap Replaced	15:30-16:30	0	21.0	0.0		0.0	0.0	156	85	0.30	0.015	0	0	0.00	0.00	157	79,294	89,842	157.51	10.16	90	477	759	2.14	0.07	0	0	0.00	0.00	74,786	293,929	828.7	27.1	174.2	106.0	30.6	19.0	37.5
12	21	4	Running	9:00	23	21.0	29.0		29.0	11.7	156	85	0.30	0.015	1,830	2,463	8.69	0.43						90	477	759	2.14	0.07	5,597	21,996	62.02	2.03									
12	21	5	Running	9:00	24	20.6	29.7		29.7	12.0	156	85	0.30	0.015	1,874	2,521	8.90	0.44						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
12	21	6	Running/end run	10:00	25	20.3	30.5		30.5	12.3	156	85	0.30	0.015	1,923	2,588	9.14	0.46						90	477	759	2.14	0.07	5,880	23,112	65.16	2.13									
12	22	0	Column Start-up	8:00	0	0.0	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
12	22	1	Running	8:00	24	20.9	30.1		30.1	12.2	266	134	0.32	0.14	3,241	4,033	9.63	4.21						90	477	759	2.14	0.07	5,812	22,843	64.41	2.11									
12	22	2	Running	8:00	24	20.6	29.7		29.7	12.0	266	134	0.32	0.14	3,195	3,975	9.49	4.15						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
12	22	3	Running	8:00	24	20.5	29.5		29.5	12.0	266	134	0.32	0.14	3,179	3,956	9.45	4.13						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
12	22	4	Running	8:00	24	20.5	29.5		29.5	12.0	266	134	0.32	0.14	3,179	3,956	9.45	4.13						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
12	22	5	In Failure	8:00	24	20.6	29.7		29.7	12.0	266	134	0.32	0.14	3,195	3,975	9.49	4.15						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
12	22	5	Sand Cap Replaced	18:00-18:30	0	20.6	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00	96	21,615	27,467	74.24	22.12	90	477	759	2.14	0.07	0	0	0.00	0.00	45,877	180,307	508.4	16.6	106.9	47.1	15.2	14.6	133.0
12	22	6	Running	8:00	23.5	20.6	29.0		29.0	11.8	266	134	0.32	0.14	3,128	3,892	9.29	4.07						90	477	759	2.14	0.07	5,609	22,046	62.16	2.03									
12	22	7	Running/end run	8:30	24.5	20.3	29.8		29.8	12.1	266	134	0.32	0.14	3,214	3,999	9.55	4.18						90	477	759	2.14	0.07	5,763	22,649	63.86	2.09									
12	23	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	198	128	0.34	0.28	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
12	23	1	Running	10:00	24	20.2	29.1		29.1	11.8	198	128	0.34	0.28	2,332	3,723	9.89	8.14						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
12	23	2	Running	10:00	24	20.6	29.7		29.7	12.0	198	128	0.34	0.28	2,378	3,797	10.09	8.31						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
12	23	3	Running	10:00	24	20.4	29.4		29.4	11.9	198	128	0.34	0.28	2,355	3,760	9.99	8.23						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
12	23	4	Running	10:00	24	20.2	29.1		29.1	11.8	198	128	0.34	0.28	2,332	3,723	9.89	8.14						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
12	23	5	Running	10:00	24	20.3	29.2		29.2	11.8	198	128	0.34	0.28	2,343	3,742	9.94	8.18						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
12	23	6	Running	10:00	24	20.3	29.2		29.2	11.8	198	128	0.34	0.28	2,343	3,742	9.94	8.18						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
12	23	7	Running/end run	10:00	24	20.3	29.2		29.2	11.8	198	128	0.34	0.28	2,343	3,742	9.94	8.18						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
12	24	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
12	24	1	Running	10:00	24	21.0	30.2		30.2	12.2	330	162	0.55	0.32	4,040	4,899	16.63	9.68						90	477	759	2.14	0.07	5,840	22,952	64.71	2.12									
12	24	2	Running	10:00	24	20.9	30.1		30.1	12.2	330	162	0.55	0.32	4,021	4,876	16.55	9.63						90	477	759	2.14	0.07	5,812	22,843	64.41	2.11									
12	24	3	Running	10:00	24	20.7	29.8		29.8	12.1	330	162	0.55	0.32	3,982	4,829	16.39	9.54						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
12	24	4	Running	10:00	24	20.8	30.0		30.0	12.1	330	162	0.55	0.32	4,002	4,852	16.47	9.58						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
12	24	5	Running	10:00	24	21.0	30.2		30.2	12.2	330	162	0.55	0.32	4,040	4,899	16.63	9.68						90	477	759	2.14	0.07	5,840	22,952	64.71	2.12									
12	24	6	Running	10:00	24	20.6	29.7		29.7	12.0	330	162	0.55	0.32	3,963	4,806	16.32	9.49		project end				90	477	759	2.14	0.07	5,729	22,515	63.48	2.08		project end							
12	24	7	Running/end run	10:00	24	20.3	29.2		29.2	11.8	330	162	0.55	0.32	3,905	4,736	16.08	9.35	192	50,722	68,015	203.59	132.57	90	477	759	2.14	0.07	5,645	22,187	62.56	2.05	91,351	359,031	1012.3	33.1	212.8	55.5	18.9	20.1	400.4
								SUM =	1,331	539				Project totals =	161,631	195,577	459	168	539	161,631	195,577	459	168						257,012	1,010,122	2,848	93.2	257,012	1,010,122	2,848	93.2					

Table B-14. 4-Inch Scale Filter Column Loading Calculations, Column 13, Fe-Modified Activated Alumina

Fe-Modified AA

Column Status and Filtration Volumes											Average Clarifier Concentration				Calculated Load				Calculated Load at Failure/Activity					"Typical" Tahoe Storm Water Concentrations					Calculated "Typical" Tahoe Load				Calculated "Tahoe" Load at Failure/Activity				Percent of "Typical" Tahoe Storm Water Treated				
Col	Run #	Run Day	Status/Activity	Time	Hours In-Service (hrs)	Average Flowrate (ml/min)	Calc Vol. Filtered (L)	Overflow Adjust (L)	**Volume Filtered (L)**	**Feet Filtered (ft)**	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Total Filter Load (ft)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (ft)	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (% of annual)	Turb (%)	TSS (%)	Tot-P (%)	Dis-P (%)
13	18	0	Column Start-up	8:20	0	0.0	0.0		0.0	0.0	106	44	0.10	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
13	18	1	Running	8:20	24	20.7	29.8		29.8	12.1	106	44	0.10	0.015	1,279	1,312	2.98	0.45						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
13	18	2	Running	8:20	24	20.9	30.1		30.1	12.2	106	44	0.10	0.015	1,292	1,324	3.01	0.45						90	477	759	2.14	0.07	5,812	22,843	64.41	2.11									
13	18	3	Running	8:20	24	20.4	29.4		29.4	11.9	106	44	0.10	0.015	1,261	1,293	2.94	0.44						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
13	18	4	Running	8:20	24	20.0	28.8		28.8	11.7	106	44	0.10	0.015	1,236	1,267	2.88	0.43						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
13	18	5	Running	8:20	24	19.9	28.7		28.7	11.6	106	44	0.10	0.015	1,230	1,261	2.87	0.43						90	477	759	2.14	0.07	5,534	21,750	61.32	2.01									
13	18	6	Running	8:20	24	20.1	28.9		28.9	11.7	106	44	0.10	0.015	1,242	1,274	2.89	0.43						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
13	18	7	Running	8:20	24	20.0	28.8		28.8	11.7	106	44	0.10	0.015	1,236	1,267	2.88	0.43						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
13	18	8	Running/end run	8:15	24	20.0	28.8		28.8	11.7	106	44	0.10	0.015	1,236	1,267	2.88	0.43						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
13	19	0	Column Start-up	12:00	0	0.0	0.0		0.0	0.0	591	272	0.24	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
13	19	1	In Failure	12:00	24	20.7	29.8	15.1	14.7	6.0	591	272	0.24	0.015	3,519	4,001	3.53	0.22						90	477	759	2.14	0.07	2,840	11,163	31.48	1.03									
13	19	1	Sand Cap Replaced	8:30-11:00	0	20.7	0.0		0.0	0.0	591	272	0.24	0.015	0	0	0.00	0.00	100	13,530	14,265	26.86	3.72	90	477	759	2.14	0.07	0	0	0.00	0.00	47,891	188,223	530.7	17.4	111.6	28.3	7.6	5.1	21.4
13	19	2	Running	12:00	21.5	20.5	26.4		26.4	10.7	591	272	0.24	0.015	6,328	7,193	6.35	0.40						90	477	759	2.14	0.07	5,107	20,072	56.59	1.85									
13	19	3	Running	12:00	24	21.1	30.4		30.4	12.3	591	272	0.24	0.015	7,270	8,264	7.29	0.46						90	477	759	2.14	0.07	5,868	23,061	65.02	2.13									
13	19	4	Running/end run	13:30	25.5	21.6	33.0		33.0	13.4	591	272	0.24	0.015	7,907	8,989	7.93	0.50						90	477	759	2.14	0.07	6,382	25,083	70.72	2.31									
13	20	0	Column Start-up	8:30	0	0.0	0.0		0.0	0.0	627	280	0.58	0.04	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
13	20	1	Running	8:30	24	20.3	29.2		29.2	11.8	627	280	0.58	0.04	7,420	8,185	16.95	1.17						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
13	20	2	In Failure	8:30	24	19.3	27.8	13.2	14.6	5.9	627	280	0.58	0.04	3,704	4,086	8.46	0.58						90	477	759	2.14	0.07	2,818	11,075	31.23	1.02									
13	20	2	Sand Cap Replaced	15:00-16:30	0	19.3	0.0		0.0	0.0	627	280	0.58	0.04	0	0	0.00	0.00	54	32,630	36,717	46.99	3.10	90	477	759	2.14	0.07	0	0	0.00	0.00	25,820	101,479	286.1	9.4	60.1	126.4	36.2	16.4	33.1
13	20	3	Running	8:30	22.5	19.8	26.7		26.7	10.8	627	280	0.58	0.04	6,785	7,484	15.50	1.07						90	477	759	2.14	0.07	5,162	20,288	57.20	1.87									
13	20	4	Running	8:30	24	19.9	28.7		28.7	11.6	627	280	0.58	0.04	7,274	8,024	16.62	1.15						90	477	759	2.14	0.07	5,534	21,750	61.32	2.01									
13	20	5	Running	8:30	24	20.1	28.9		28.9	11.7	627	280	0.58	0.04	7,347	8,104	16.79	1.16						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
13	20	6	Running/end run	9:00	24.5	20.2	29.7		29.7	12.0	627	280	0.58	0.04	7,538	8,314	17.22	1.19																							
																								90	477	759	2.14	0.07	0	0	0.00	0.00									
13	21	0	Column Start-up	9:00	0	0.0	0.0		0.0	0.0	156	85	0.30	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
13	21	1	In Failure	8:30	23.5	20.7	29.2	14.2	15.0	6.1	156	85	0.30	0.015	947	1,274	4.50	0.22						90	477	759	2.14	0.07	2,894	11,375	32.07	1.05									
13	21	1	2" Media Replaced	8:30-10:30	0	20.7	0.0		0.0	0.0	156	85	0.30	0.015	0	0	0.00	0.00	52	29,891	33,201	70.63	4.79	90	477	759	2.14	0.07	0	0	0.00	0.00	19,180	75,382	212.5	7.0	58.0	155.8	44.0	33.2	68.8
13	21	2	In Failure	8:30	22	20.9	27.6	11.4	16.2	6.6	156	85	0.30	0.015	1,022	1,376	4.86	0.24						90	477	759	2.14	0.07	3,126	12,287	34.64	1.13									
13	21	3	In Failure	9:00	24.5	21.1	31.0		31.0	12.6	156	85	0.30	0.015	1,959	2,636	9.31	0.47						90	477	759	2.14	0.07	5,990	23,542	66.38	2.17									
13	21	3	In Failure	15:30	6.5	21.1	8.2	3.8	4.4	1.8	156	85	0.30	0.015	280	376	1.33	0.07						90	477	759	2.14	0.07	855	3,362	9.48	0.31									
13	21	4	Running	9:00	17.5	20.5	21.5		21.5	8.7	156	85	0.30	0.015	1,359	1,830	6.46	0.32						90	477	759	2.14	0.07	4,157	16,337	46.06	1.51									
13	21	5	Running	9:00	24	20.5	29.5		29.5	12.0	156	85	0.30	0.015	1,864	2,509	8.86	0.44						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
13	21	6	Running/end run	10:00	25	20.7	31.1		31.1	12.6	156	85	0.30	0.015	1,961	2,639	9.32	0.47						90	477	759	2.14	0.07	5,996	23,567	66.45	2.17									
13	22	0	Column Start-up	8:00	0	0.0	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
13	22	1	In Failure	8:00	24	20.7	29.8	7.6	22.2	9.0	266	134	0.32	0.14	2,392	2,976	7.11	3.11						90	477	759	2.14	0.07	4,289	16,856	47.53	1.55									
13	22	1	Sand Cap Replaced	10:00-11:00	0	20.7	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00	63	10,838	14,343	47.23	5.12	90	477	759	2.14	0.07	0	0	0.00	0.00	30,114	118,356	333.7	10.9	70.1	36.0	12.1	14.2	46.9
13	22	2	In Failure	8:45	23.75	21.0	29.9	7.6	22.3	9.0	266	134	0.32	0.14	2,404	2,992	7.14	3.13						90	477	759	2.14	0.07	4,311	16,945	47.78	1.56									
13	22	3	In Failure	8:00	23.25	20.9	29.2		29.2	11.8	266	134	0.32	0.14	3,140	3,907	9.33	4.08						90	477	759	2.14	0.07	5,630	22,129	62.39	2.04									
13	22	3	6" Media Replaced	15:00-16:00	0	20.9	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00	21	5,544	6,898	16.47	7.21	90	477	759	2.14	0.07	0	0	0.00	0.00	9,942	39,074	110.2	3.6	23.2	55.8	17.7	15.0	200.0
13	22	4	In Failure	8:30	23.5	20.8	29.3	1.9	27.4	11.1	266	134	0.32	0.14	2,954	3,675	8.78	3.84						90	477	759	2.14	0.07	5,297	20,818	58.70	1.92									
13	22	5	In Failure	8:00	0	20.7	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00																							
13	22	5	Off Line	17:00	9	20.7	11.2		11.2	4.5	266	134	0.32	0.14	1,204	1,498	3.58	1.56						90	477	759	2.14	0.07	2,159	8,484	23.92	0.78									
13	22	6	Off Line	--	--	--	--		--	-	-	-	-	-	-	-	-	-						-	-	-	-	-	-	-	-	-									
13	22	7	Off Line	--	--	--	--		--	-	-	-	-	-	-	-	-	-						-	-	-	-	-	-	-	-	-									
13	23	0	12" of Media Removed																16	4,158	5,173	12.35	5.40	90	477	759	2.14	0.07	0	0	0.00	0.00	7,455	29,302	82.6	2.7	17.4	55.8	17.7	15.0	200.0
13	23	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	198	128	0.34	0.28	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
13	23	1	Running as 12" filter	10:00	24	20.3	29.2		29.2	11.8	198	128	0.34	0.28	2,343	3,742	9.94	8.18						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
13	23	2	Running as 12" filter	10:00	24	21.0	30.2		30.2	12.2	198	128	0.34	0.28	2,424	3,871	10.28	8.47						90	477	759	2.14	0.07	5,840	22,952	64.71	2.12									
13	23	3	Running as 12" filter	10:00	24	20.7	29.8		29.8	12.1	198	128	0.34	0.28	2,389	3,815	10.13	8.35						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
13	23	4	Running as 12" filter	10:00	24	20.5	29.5		29.5	12.0	198	128	0.34	0.28	2,366	3,779	10.04	8.27						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
13	23	5	Running as 12" filter	10:00	24	20.6	29.7		29.7	12.0	198	128	0.34	0.28	2,378	3,797	10.09	8.31						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
13	23	6	Running as 12" filter	10:00	24	20.4	29.4		29.4	11.9	198	128	0.34	0.28	2,355	3,760	9.99	8.23						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
13	23	7	Running/end run	10:00	24	20.3	29.2		29.2	11.8	198	128	0.34	0.28	2,343	3,742	9.94	8.18						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
13	24	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
13	24	1	Running as 12" filter	10:00	24	20.6	29.7		29.7	12.0	330	162	0.55	0.32	3,963	4,806	16.32	9.49						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
13	24	2	Running as 12" filter	10:00	24	20.2	29.1		29.1	11.8	330	162	0.55	0.32	3,886	4,712	16.00	9.31						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
13	24	3	Running as 12" filter	10:00	24	20.5	29.5		29.5	12.0	330	162	0.55	0.32	3,944	4,782	16.24	9.45						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
13	24	4	Running as 12" filter	10:00	24	20.7	29.8		29.8	12.1	330	162	0.55	0.32	3,983	4,829	16.39	9.54						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
13	24	5	Running as 12" filter	10:00	24	20.4	29.4		29.4	11.9	330	162	0.55	0.32	3,925	4,759	16.16	9.40						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
13	24	6	Running as 12" filter	10:00	24	20.6	29.7		29.7	12.0	330	162	0.55	0.32	3,963	4,806	16.32	9.49		project end				90	477	759	2.14	0.07	5,729	22,515	63.48	2.08		project end							
13	24	7	Running/end run	10:00	24	20.6	29.7		29.7	12.0	330	162	0.55	0.32	3,963	4,806	16.32	9.49	168	44,226	60,004	184.14	124.15	90	477	759	2.14	0.07	5,729	22,515	63.48	2.08	79,923	314,117	885.7	29.0	186.2	55.3	19.1	20.8	428.6
								SUM =	1,171	474			Project totals =		140,817	170,601	405	153	474	140,817	170,601	405	153						220,325	865,932	2,441	79.9	220,325	865,932	2,441	79.9					

Table B-15. 4-Inch Scale Filter Column Loading Calculations, Column 14, Fe-Modified Activated Alumina

Fe-Modified AA			Column Status and Filtration Volumes								Average Clarifier Concentration				Calculated Load				Calculated Load at Failure/Activity					"Typical" Tahoe Storm Water Concentrations					Calculated "Typical" Tahoe Load				Calculated "Tahoe" Load at Failure/Activity				Percent of "Typical" Tahoe Storm Water Treated				
Col	Run #	Run Day	Status/Activity	Time	Hours In-Service (hrs)	Average Flowrate (ml/min)	Calc Vol. Filtered (L)	Overflow Adjust (L)	**Volume Filtered (L)**	**Feet Filtered (ft)**	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Total Filter Load (ft)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (ft)	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (% of annual)	Turb (%)	TSS (%)	Tot-P (%)	Dis-P (%)
14	18	0	Column Start-up	8:20	0	0.0	0.0		0.0	0.0	106	44	0.10	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
14	18	1	Running	8:20	24	20.6	29.7		29.7	12.0	106	44	0.10	0.015	1,273	1,305	2.97	0.44						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
14	18	2	Running	8:20	24	20.7	29.8		29.8	12.1	106	44	0.10	0.015	1,279	1,312	2.98	0.45						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
14	18	3	Running	8:20	24	20.7	29.8		29.8	12.1	106	44	0.10	0.015	1,279	1,312	2.98	0.45						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
14	18	4	Running	8:20	24	20.5	29.5		29.5	12.0	106	44	0.10	0.015	1,267	1,299	2.95	0.44						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
14	18	5	Running	8:20	24	20.3	29.2		29.2	11.8	106	44	0.10	0.015	1,254	1,286	2.92	0.44						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
14	18	6	Running	8:20	24	20.3	29.2		29.2	11.8	106	44	0.10	0.015	1,254	1,286	2.92	0.44						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
14	18	7	In Failure	8:20	24	20.2	29.1	0.4	28.7	11.6	106	44	0.10	0.015	1,231	1,262	2.87	0.43						90	477	759	2.14	0.07	5,540	21,774	61.39	2.01									
14	18	7	Sand Cap Replaced	8:30-9:30	0	20.2	0.0		0.0	0.0	106	44	0.10	0.015	0	0	0.00	0.00	83	8,838	9,062	20.60	3.09	90	477	759	2.14	0.07	0	0	0.00	0.00	39,773	156,318	440.7	14.4	92.6	22.2	5.8	4.7	21.4
14	18	8	Running/end run	8:15	23	20.3	28.0		28.0	11.3	106	44	0.10	0.015	1,202	1,233	2.80	0.42																							
																								90	477	759	2.14	0.07	0	0	0.00	0.00									
14	19	0	Column Start-up	12:00	0	0.0	0.0		0.0	0.0	591	272	0.24	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
14	19	1	Running	12:00	24	20.8	30.0		30.0	12.1	591	272	0.24	0.015	7,167	8,147	7.19	0.45						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
14	19	2	Running	12:00	24	20.7	29.8		29.8	12.1	591	272	0.24	0.015	7,132	8,108	7.15	0.45						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
14	19	3	Running	12:00	24	21.2	30.5		30.5	12.4	591	272	0.24	0.015	7,304	8,304	7.33	0.46						90	477	759	2.14	0.07	5,895	23,171	65.33	2.14									
14	19	4	Running/end run	13:30	25.5	21.6	33.0		33.0	13.4	591	272	0.24	0.015	7,907	8,989	7.93	0.50						90	477	759	2.14	0.07	6,382	25,083	70.72	2.31									
14	20	0	Column Start-up	8:30	0	0.0	0.0		0.0	0.0	627	280	0.58	0.04	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
14	20	1	Running	8:30	24	20.6	29.7		29.7	12.0	627	280	0.58	0.04	7,530	8,306	17.21	1.19						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
14	20	2	In Failure	8:30	24	20.0	28.8	10.4	18.4	7.4	627	280	0.58	0.04	4,671	5,152	10.67	0.74						90	477	759	2.14	0.07	3,553	13,966	39.38	1.29									
14	20	2	Sand Cap Replaced	15:00-16:30	0	20.0	0.0		0.0	0.0	627	280	0.58	0.04	0	0	0.00	0.00	81	42,914	48,238	60.28	4.19	90	477	759	2.14	0.07	0	0	0.00	0.00	33,100	130,093	366.8	12.0	89.7	129.6	37.1	16.4	34.9
14	20	3	Running	8:30	22.5	20.0	27.0		27.0	10.9	627	280	0.58	0.04	6,854	7,560	15.66	1.08						90	477	759	2.14	0.07	5,214	20,493	57.78	1.89									
14	20	4	Running	8:30	24	19.7	28.4		28.4	11.5	627	280	0.58	0.04	7,201	7,943	16.45	1.13						90	477	759	2.14	0.07	5,478	21,531	60.71	1.99									
14	20	5	Running	8:30	24	20.2	29.1		29.1	11.8	627	280	0.58	0.04	7,384	8,145	16.87	1.16						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
14	20	6	In Failure	9:00	24.5	20.3	29.8	1.0	28.9	11.7	627	280	0.58	0.04	7,334	8,089	16.76	1.16						90	477	759	2.14	0.07	5,579	21,928	61.83	2.02									
14	21	0	Sand Cap Replaced	8:00-9:00	--	--	--		--										46	28,773	31,737	65.74	4.53										21,889	86,030	242.6	7.9	51.0	131.4	36.9	27.1	57.1
14	21	0	Column Start-up	9:00	0	0.0	0.0		0.0	0.0	156	85	0.30	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
14	21	1	In Failure	8:30	23.5	20.9	29.5	15.1	14.4	5.8	156	85	0.30	0.015	908	1,221	4.31	0.22						90	477	759	2.14	0.07	2,775	10,906	30.75	1.01									
14	21	1	2" Media Replaced	8:30-10:30	0	20.9	0.0		0.0	0.0	156	85	0.30	0.015	0	0	0.00	0.00	6	908	1,221	4.31	0.22	90	477	759	2.14	0.07	0	0	0.00	0.00	2,775	10,906	30.7	1.0	6.5	32.7	11.2	14.0	21.4
14	21	2	In Failure	8:30	22	20.4	26.9	7.6	19.3	7.8	156	85	0.30	0.015	1,221	1,643	5.80	0.29						90	477	759	2.14	0.07	3,733	14,670	41.36	1.35									
14	21	3	Running	9:00	24.5	20.8	30.6		30.6	12.4	156	85	0.30	0.015	1,931	2,599	9.17	0.46						90	477	759	2.14	0.07	5,905	23,207	65.43	2.14									
14	21	3	In Failure	15:30	0	20.8	0.0	7.6	-7.6	-3.1	156	85	0.30	0.015	-480	-646	-2.28	-0.11						90	477	759	2.14	0.07	-1,468	-5,768	-16.26	-0.53									
14	21	4	In Failure	9:00	24	21.4	30.8		30.8	12.5	156	85	0.30	0.015	1,946	2,619	9.24	0.46						90	477	759	2.14	0.07	5,951	23,389	65.95	2.16									
14	21	5	In Failure	8:30	23.5	20.6	29.0	4.5	24.5	9.9	156	85	0.30	0.015	1,550	2,086	7.36	0.37						90	477	759	2.14	0.07	4,740	18,630	52.53	1.72									
14	21	6	In Failure	10:00	25	20.3	30.5	7.6	22.9	9.3	156	85	0.30	0.015	1,443	1,942	6.86	0.34						90	477	759	2.14	0.07	4,413	17,343	48.90	1.60									
14	22	0	Column Start-up	8:00	0	0.0	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
14	22	1	In Failure	8:00	24	20.2	29.1	13.2	15.9	6.4	266	134	0.32	0.14	1,711	2,129	5.08	2.22						90	477	759	2.14	0.07	3,068	12,059	34.00	1.11									
14	22	1	Sand Cap Replaced	10:00-11:00	0	20.2	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00	55	9,323	12,373	41.24	4.03	90	477	759	2.14	0.07	0	0	0.00	0.00	26,342	103,531	291.9	9.5	61.4	35.4	12.0	14.1	42.2
14	22	2	In Failure	8:45	23.75	20.1	28.6	11.4	17.2	7.0	266	134	0.32	0.14	1,857	2,310	5.52	2.41						90	477	759	2.14	0.07	3,330	13,087	36.90	1.21									
14	22	3	In Failure	8:00	23.25	20.3	28.3		28.3	11.5	266	134	0.32	0.14	3,050	3,795	9.06	3.96						90	477	759	2.14	0.07	5,469	21,494	60.60	1.98									
14	22	3	6" Media Replaced	15:00-16:30	0	20.3	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00	18	4,907	6,105	14.58	6.38										8,799	34,581	97.5	3.2	20.5	55.8	17.7	15.0	200.0
14	22	4	In Failure	8:30	23.5	20.4	28.8	1.9	26.9	10.9	266	134	0.32	0.14	2,893	3,600	8.60	3.76						90	477	759	2.14	0.07	5,188	20,390	57.49	1.88									
14	22	5	In Failure	8:00	0	20.3	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
14	22	5	Off Line	17:00	9	20.3	11.0		11.0	4.4	266	134	0.32	0.14	1,181	1,469	3.51	1.53						90	477	759	2.14	0.07	2,117	8,320	23.46	0.77									
14	22	6	Off Line	--	--	--	--		--	-	-		-	-	-		-	-						-	-	-	-	-	-	-	-	-									
14	22	7	Off Line	--	--	--	--		--	-	-	-	-	-	-	-	-	-						-	-	-	-	-	-	-	-	-									
14	23	0	12" of Media Removed							0.0	198	128	0.34	0.28	0	0	0.00	0.00	15	4,074	5,069	12.10	5.30	90	477	759	2.14	0.07	0	0	0.00	0.00	7,305	28,710	80.9	2.6	17.0	55.8	17.7	15.0	200.0
14	23	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	198	128	0.34	0.28	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
14	23	1	Running as 12" filter	10:00	24	20.4	29.4		29.4	11.9	198	128	0.34	0.28	2,355	3,760	9.99	8.23						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
14	23	2	Running as 12" filter	10:00	24	20.7	29.8		29.8	12.1	198	128	0.34	0.28	2,389	3,815	10.13	8.35						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
14	23	3	Running as 12" filter	10:00	24	20.7	29.8		29.8	12.1	198	128	0.34	0.28	2,389	3,815	10.13	8.35						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
14	23	4	Running as 12" filter	10:00	24	20.5	29.5		29.5	12.0	198	128	0.34	0.28	2,366	3,779	10.04	8.27						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
14	23	5	Running as 12" filter	10:00	24	20.5	29.5		29.5	12.0	198	128	0.34	0.28	2,366	3,779	10.04	8.27						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
14	23	6	Running as 12" filter	10:00	24	20.1	28.9		28.9	11.7	198	128	0.34	0.28	2,320	3,705	9.84	8.10						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
14	23	7	Running/end run	10:00	24	20.0	28.8		28.8	11.7	198	128	0.34	0.28	2,309	3,686	9.79	8.06						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
14	24	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
14	24	1	Running as 12" filter	10:00	24	20.7	29.8		29.8	12.1	330	162	0.55	0.32	3,982	4,829	16.39	9.54						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
14	24	2	Running as 12" filter	10:00	24	20.5	29.5		29.5	12.0	330	162	0.55	0.32	3,944	4,782	16.24	9.45						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
14	24	3	Running as 12" filter	10:00	24	20.3	29.2		29.2	11.8	330	162	0.55	0.32	3,905	4,736	16.08	9.35						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
14	24	4	Running as 12" filter	10:00	24	20.6	29.7		29.7	12.0	330	162	0.55	0.32	3,963	4,806	16.32	9.49						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
14	24	5	Running as 12" filter	10:00	24	20.8	30.0		30.0	12.1	330	162	0.55	0.32	4,002	4,852	16.47	9.58						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
14	24	6	Running as 12" filter	10:00	24	20.6	29.7		29.7	12.0	330	162	0.55	0.32	3,963	4,806	16.32	9.49		project end				90	477	759	2.14	0.07	5,729	22,515	63.48	2.08		project end							
14	24	7	Running/end run	10:00	24	20.3	29.2		29.2	11.8	330	162	0.55	0.32	3,905	4,736	16.08	9.35	167	44,161	59,885	183.85	123.88	90	477	759	2.14	0.07	5,645	22,187	62.56	2.05	79,728	313,352	883.5	28.9	185.7	55.4	19.1	20.8	428.7
								SUM =	1,166	472			Project totals =		143,896	173,690	403	152	472	143,896	173,690	403	152						219,711	863,520	2,435	79.6	219,711	863,520	2,435	79.6					

Table B-16. 4-Inch Scale Filter Column Loading Calculations, Column 15, Granular Ferric Hydroxide

GFH

Column Status and Filtration Volumes											Average Clarifier Concentration				Calculated Load				Calculated Load at Failure/Activity					"Typical" Tahoe Storm Water Concentrations					Calculated "Typical" Tahoe Load				Calculated "Tahoe" Load at Failure/Activity				Percent of "Typical" Tahoe Storm Water Treated				
Col	Run #	Run Day	Status/Activity	Time	Hours In-Service (hrs)	Average Flowrate (ml/min)	Calc Vol. Filtered (L)	Overflow Adjust (L)	**Volume Filtered (L)**	**Feet Filtered (ft)**	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Total Filter Load (ft)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (ft)	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (% of annual)	Turb (%)	TSS (%)	Tot-P (%)	Dis-P (%)
15	18	0	Column Start-up	8:20	0	0.0	0.0		0.0	0.0	106	44	0.10	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
15	18	1	Running	8:20	24	20.8	30.0		30.0	12.1	106	44	0.10	0.015	1,285	1,318	3.00	0.45						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
15	18	2	Running	8:20	24	20.5	29.5		29.5	12.0	106	44	0.10	0.015	1,267	1,299	2.95	0.44						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
15	18	3	Running	8:20	24	20.7	29.8		29.8	12.1	106	44	0.10	0.015	1,279	1,312	2.98	0.45						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
15	18	4	Running	8:20	24	21.1	30.4		30.4	12.3	106	44	0.10	0.015	1,304	1,337	3.04	0.46						90	477	759	2.14	0.07	5,868	23,061	65.02	2.13									
15	18	5	In Failure	8:20	24	21.2	30.5	4.0	26.5	10.7	106	44	0.10	0.015	1,138	1,167	2.65	0.40						90	477	759	2.14	0.07	5,123	20,135	56.77	1.86									
15	18	5	Sand Cap Replaced	10:00-12:00	0	21.2	0.0		0.0	0.0	106	44	0.10	0.015	0	0	0.00	0.00	59	6,274	6,432	14.62	2.19	90	477	759	2.14	0.07	0	0	0.00	0.00	28,232	110,960	312.9	10.2	65.8	22.2	5.8	4.7	21.4
15	18	6	Running	8:20	22	21.2	28.0		28.0	11.3	106	44	0.10	0.015	1,201	1,231	2.80	0.42						90	477	759	2.14	0.07	5,404	21,240	59.89	1.96									
15	18	7	Running	8:20	24	20.9	30.1		30.1	12.2	106	44	0.10	0.015	1,292	1,324	3.01	0.45						90	477	759	2.14	0.07	5,812	22,843	64.41	2.11									
15	18	8	Running/end run	8:15	24	20.4	29.4		29.4	11.9	106	44	0.10	0.015	1,261	1,293	2.94	0.44						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
15	19	0	Column Start-up	12:00	0	0.0	0.0		0.0	0.0	591	272	0.24	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
15	19	1	Running	12:00	24	20.5	29.5	5.7	23.8	9.6	591	272	0.24	0.015	5,699	6,479	5.72	0.36						90	477	759	2.14	0.07	4,600	18,079	50.97	1.67									
15	19	2	Sand Cap Replaced	11:00-11:30	0	20.5	0.0		0.0	0.0	591	272	0.24	0.015	0	0	0.00	0.00	45	9,453	10,327	14.46	1.67	90	477	759	2.14	0.07	0	0	0.00	0.00	21,489	84,458	238.1	7.8	50.1	44.0	12.2	6.1	21.4
15	19	2	Running	12:00	23.5	21.1	29.8		29.8	12.0	591	272	0.24	0.015	7,119	8,092	7.14	0.45						90	477	759	2.14	0.07	5,745	22,581	63.67	2.08									
15	19	3	Running	12:00	24	21.3	30.7		30.7	12.4	591	272	0.24	0.015	7,339	8,343	7.36	0.46						90	477	759	2.14	0.07	5,923	23,280	65.64	2.15									
15	19	4	Running/end run	13:30	25.5	21.3	32.6		32.6	13.2	591	272	0.24	0.015	7,798	8,864	7.82	0.49						90	477	759	2.14	0.07	6,294	24,735	69.74	2.28									
15	20	0	Column Start-up	8:30	0	0.0	0.0		0.0	0.0	627	280	0.58	0.04	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
15	20	1	Running	8:30	24	20.7	29.8		29.8	12.1	627	280	0.58	0.04	7,567	8,346	17.29	1.19						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
15	20	2	Running	8:30	24	20.3	29.2		29.2	11.8	627	280	0.58	0.04	7,420	8,185	16.95	1.17						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
15	20	3	Running	8:30	24	20.2	29.1		29.1	11.8	627	280	0.58	0.04	7,384	8,145	16.87	1.16						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
15	20	4	Running	8:30	24	20.1	28.9		28.9	11.7	627	280	0.58	0.04	7,347	8,104	16.79	1.16						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
15	20	5	Running	8:30	24	20.0	28.8		28.8	11.7	627	280	0.58	0.04	7,311	8,064	16.70	1.15						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
15	20	6	Running/end run	9:00	24.5	20.0	29.4		29.4	11.9	627	280	0.58	0.04	7,463	8,232	17.05	1.18						90	477	759	2.14	0.07	5,678	22,315	62.92	2.06									
15	21	0	Column Start-up	9:00	0	0.0	0.0		0.0	0.0	156	85	0.30	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
15	21	1	In Failure	8:30	23.5	20.3	28.6	11.4	17.2	7.0	156	85	0.30	0.015	1,088	1,464	5.17	0.26						90	477	759	2.14	0.07	3,326	13,072	36.86	1.21									
15	21	1	2" Media Replaced	8:30-10:30	0	20.3	0.0		0.0	0.0	156	85	0.30	0.015	0	0	0.00	0.00	116	67,835	75,839	129.15	8.66	90	477	759	2.14	0.07	0	0	0.00	0.00	55,136	216,700	611.0	20.0	128.4	123.0	35.0	21.1	43.4
15	21	2	Running	8:30	22	20.7	27.3		27.3	11.1	156	85	0.30	0.015	1,726	2,323	8.20	0.41						90	477	759	2.14	0.07	5,277	20,739	58.47	1.91									
15	21	3	Running	9:00	24.5	20.6	30.3		30.3	12.3	156	85	0.30	0.015	1,913	2,574	9.08	0.45						90	477	759	2.14	0.07	5,848	22,984	64.80	2.12									
15	21	4	Running	9:00	24	19.2	27.6		27.6	11.2	156	85	0.30	0.015	1,746	2,350	8.29	0.41						90	477	759	2.14	0.07	5,339	20,985	59.17	1.94									
15	21	5	Running	9:00	24	21.2	30.5		30.5	12.4	156	85	0.30	0.015	1,928	2,595	9.16	0.46						90	477	759	2.14	0.07	5,895	23,171	65.33	2.14									
15	21	6	Running/end run	10:00	25	20.0	30.0		30.0	12.1	156	85	0.30	0.015	1,895	2,550	9.00	0.45						90	477	759	2.14	0.07	5,794	22,770	64.20	2.10									
15	22	0	Column Start-up	8:00	0	0.0	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
15	22	1	Running	8:00	24	20.2	29.1		29.1	11.8	266	134	0.32	0.14	3,133	3,898	9.31	4.07						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
15	22	2	In Failure	8:45	24.75	20.0	29.7	1.2	28.5	11.5	266	134	0.32	0.14	3,069	3,819	9.12	3.99						90	477	759	2.14	0.07	5,504	21,632	60.99	2.00									
15	22	3	Running	8:00	23.25	20.0	27.9		27.9	11.3	266	134	0.32	0.14	3,005	3,739	8.93	3.91						90	477	759	2.14	0.07	5,388	21,176	59.71	1.95									
15	22	4	Running	8:00	24	20.1	28.9		28.9	11.7	266	134	0.32	0.14	3,117	3,878	9.26	4.05						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
15	22	5	In Failure	8:00	24	20.1	28.9		28.9	11.7	266	134	0.32	0.14	3,117	3,878	9.26	4.05						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
15	22	5	Sand Cap Replaced	12:15-12:45	0	20.1	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00	117	24,648	31,604	89.61	22.26	90	477	759	2.14	0.07	0	0	0.00	0.00	55,841	219,471	618.8	20.2	130.1	44.1	14.4	14.5	110.0
15	22	6	Running	8:00	23.5	20.0	28.2		28.2	11.4	266	134	0.32	0.14	3,037	3,779	9.02	3.95						90	477	759	2.14	0.07	5,446	21,404	60.35	1.97									
15	22	7	Running/end run	8:30	24.5	20.0	29.4		29.4	11.9	266	134	0.32	0.14	3,166	3,940	9.41	4.12						90	477	759	2.14	0.07	5,678	22,315	62.92	2.06									
15	23	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	198	128	0.34	0.28	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
15	23	1	Running	10:00	24	20.5	29.5		29.5	12.0	198	128	0.34	0.28	2,366	3,779	10.04	8.27						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
15	23	2	Running	10:00	24	20.7	29.8		29.8	12.1	198	128	0.34	0.28	2,389	3,815	10.13	8.35						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
15	23	3	Running	10:00	24	20.2	29.1		29.1	11.8	198	128	0.34	0.28	2,332	3,723	9.89	8.14						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
15	23	4	Running	10:00	24	20.4	29.4		29.4	11.9	198	128	0.34	0.28	2,355	3,760	9.99	8.23						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
15	23	5	Running	10:00	24	20.8	30.0		30.0	12.1	198	128	0.34	0.28	2,401	3,834	10.18	8.39						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
15	23	6	Running	10:00	24	20.7	29.8		29.8	12.1	198	128	0.34	0.28	2,389	3,815	10.13	8.35						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
15	23	7	Running/end run	10:00	24	20.7	29.8		29.8	12.1	198	128	0.34	0.28	2,389	3,815	10.13	8.35						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
15	24	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
15	24	1	In Failure	10:00	24	20.2	29.1	15.1	14.0	5.7	330	162	0.55	0.32	1,869	2,266	7.69	4.48						90	477	759	2.14	0.07	2,701	10,617	29.93	0.98									
15	24	1	Sand Cap Replaced	11:30-12:00	0	20.2	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00	113	24,694	36,527	96.63	70.60	90	477	759	2.14	0.07	0	0	0.00	0.00	53,870	211,722	596.9	19.5	125.5	45.8	17.3	16.2	361.6
15	24	2	In Failure	10:00	23.5	20.5	28.9	18.9	10.0	4.1	330	162	0.55	0.32	1,337	1,621	5.50	3.20						90	477	759	2.14	0.07	1,932	7,594	21.41	0.70									
15	24	3	In Failure	10:00	24	20.4	29.4	18.9	10.5	4.2	330	162	0.55	0.32	1,400	1,697	5.76	3.35						90	477	759	2.14	0.07	2,023	7,951	22.42	0.73									
15	24	4	In Failure	10:00	24	20.6	29.7	18.9	10.8	4.4	330	162	0.55	0.32	1,438	1,744	5.92	3.44						90	477	759	2.14	0.07	2,079	8,170	23.03	0.75									
15	24	4	1" Media Replaced	13:30-14:00	0	20.6	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00	13	4,174	5,062	17.18	10.00	90	477	759	2.14	0.07	0	0	0.00	0.00	6,034	23,715	66.9	2.2	14.1	69.2	21.3	25.7	457.1
15	24	5	Running	10:00	23.5	20.5	28.9		28.9	11.7	330	162	0.55	0.32	3,862	4,683	15.90	9.25						90	477	759	2.14	0.07	5,582	21,939	61.86	2.02									
15	24	6	Running	10:00	24	20.2	29.1		29.1	11.8	330	162	0.55	0.32	3,886	4,712	16.00	9.31		project end				90	477	759	2.14	0.07	5,617	22,078	62.25	2.04		project end							
15	24	7	Running/end run	10:00	24	20.0	28.8		28.8	11.7	330	162	0.55	0.32	3,848	4,666	15.84	9.22	35	11,596	14,060	47.74	27.77	90	477	759	2.14	0.07	5,562	21,859	61.63	2.02	16,761	65,876	185.7	6.1					
								SUM =	1,229	498				Project totals =	148,674	179,851	409	143	498	148,674	179,851	409	143						237,364	932,901	2,630	86	237,364	932,901	2,630	86.0					

Table B-17. 4-Inch Scale Filter Column Loading Calculations, Column 16, Granular Ferric Hydroxide

GFH

Column Status and Filtration Volumes											Average Clarifier Concentration				Calculated Load				Calculated Load at Failure/Activity					"Typical" Tahoe Storm Water Concentrations					Calculated "Typical" Tahoe Load				Calculated "Tahoe" Load at Failure/Activity				Percent of "Typical" Tahoe Storm Water Treated				
Col	Run #	Run Day	Status/Activity	Time	Hours In-Service (hrs)	Average Flowrate (ml/min)	Calc Vol. Filtered (L)	Overflow Adjust (L)	**Volume Filtered (L)**	**Feet Filtered (ft)**	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Total Filter Load (ft)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (ft)	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (% of annual)	Turb (%)	TSS (%)	Tot-P (%)	Dis-P (%)
16	18	0	Column Start-up	8:20	0	0.0	0.0		0.0	0.0	106	44	0.10	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
16	18	1	Running	8:20	24	21.4	30.8		30.8	12.5	106	44	0.10	0.015	1,322	1,356	3.08	0.46						90	477	759	2.14	0.07	5,951	23,389	65.95	2.16									
16	18	2	Running	8:20	24	20.4	29.4		29.4	11.9	106	44	0.10	0.015	1,261	1,293	2.94	0.44						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
16	18	3	Running	8:20	24	20.4	29.4		29.4	11.9	106	44	0.10	0.015	1,261	1,293	2.94	0.44						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
16	18	4	Running	8:20	24	20.7	29.8		29.8	12.1	106	44	0.10	0.015	1,279	1,312	2.98	0.45						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
16	18	5	In Failure	8:20	24	20.6	29.7	3.7	26.0	10.5	106	44	0.10	0.015	1,114	1,142	2.60	0.39						90	477	759	2.14	0.07	5,014	19,707	55.56	1.82									
16	18	5	Sand Cap Replaced	10:00-12:00	0	20.6	0.0		0.0	0.0	106	44	0.10	0.015	0	0	0.00	0.00	59	6,237	6,395	14.53	2.18	90	477	759	2.14	0.07	0	0	0.00	0.00	28,068	110,313	311.0	10.2	65.4	22.2	5.8	4.7	21.4
16	18	6	Running	8:20	22	20.4	26.9		26.9	10.9	106	44	0.10	0.015	1,156	1,185	2.69	0.40						90	477	759	2.14	0.07	5,200	20,438	57.63	1.88									
16	18	7	Running	8:20	24	20.3	29.2		29.2	11.8	106	44	0.10	0.015	1,254	1,286	2.92	0.44						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
16	18	8	Running/end run	8:15	24	20.3	29.2		29.2	11.8	106	44	0.10	0.015	1,254	1,286	2.92	0.44						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
16	19	0	Column Start-up	12:00	0	0.0	0.0		0.0	0.0	591	272	0.24	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
16	19	1	Running	12:00	24	20.5	29.5	0.3	29.2	11.8	591	272	0.24	0.015	6,992	7,948	7.01	0.44						90	477	759	2.14	0.07	5,643	22,178	62.53	2.05									
16	19	2	Sand Cap Replaced	11:30-12:00	0	20.5	0.0		0.0	0.0	591	272	0.24	0.015	0	0	0.00	0.00	46	10,656	11,705	15.55	1.72	90	477	759	2.14	0.07	0	0	0.00	0.00	22,134	86,991	245.3	8.0	51.6	48.1	13.5	6.3	21.4
16	19	2	Running	12:00	23.5	21.1	29.8		29.8	12.0	591	272	0.24	0.015	7,119	8,092	7.14	0.45						90	477	759	2.14	0.07	5,745	22,581	63.67	2.08									
16	19	3	Running	12:00	24	20.9	30.1		30.1	12.2	591	272	0.24	0.015	7,201	8,186	7.22	0.45						90	477	759	2.14	0.07	5,812	22,843	64.41	2.11									
16	19	4	Running/end run	13:30	25.5	20.6	31.5		31.5	12.8	591	272	0.24	0.015	7,541	8,573	7.56	0.47						90	477	759	2.14	0.07	6,087	23,922	67.45	2.21									
16	20	0	Column Start-up	8:30	0	0.0	0.0		0.0	0.0	627	280	0.58	0.04	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
16	20	1	Running	8:30	24	20.3	29.2		29.2	11.8	627	280	0.58	0.04	7,420	8,185	16.95	1.17						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
16	20	2	Running	8:30	24	20.1	28.9		28.9	11.7	627	280	0.58	0.04	7,347	8,104	16.79	1.16						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
16	20	3	Running	8:30	24	20.3	29.2		29.2	11.8	627	280	0.58	0.04	7,420	8,185	16.95	1.17						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
16	20	4	Running	8:30	24	20.0	28.8		28.8	11.7	627	280	0.58	0.04	7,311	8,064	16.70	1.15						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
16	20	5	Running	8:30	24	20.0	28.8		28.8	11.7	627	280	0.58	0.04	7,311	8,064	16.70	1.15						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
16	20	6	Running/end run	9:00	24.5	20.0	29.4		29.4	11.9	627	280	0.58	0.04	7,463	8,232	17.05	1.18						90	477	759	2.14	0.07	5,678	22,315	62.92	2.06									
16	21	0	Column Start-up	9:00	0	0.0	0.0		0.0	0.0	156	85	0.30	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
16	21	1	In Failure	8:30	23.5	20.2	28.5	1.0	27.5	11.1	156	85	0.30	0.015	1,739	2,340	8.26	0.41						90	477	759	2.14	0.07	5,317	20,897	58.92	1.93									
16	21	1	2" Media Replaced	8:30-10:30	0	20.2	0.0		0.0	0.0	156	85	0.30	0.015	0	0	0.00	0.00	119	67,873	76,026	131.34	8.76	90	477	759	2.14	0.07	0	0	0.00	0.00	56,642	222,618	627.7	20.5	131.9	119.8	34.2	20.9	42.7
16	21	2	Running	8:30	22	20.4	26.9		26.9	10.9	156	85	0.30	0.015	1,701	2,289	8.08	0.40						90	477	759	2.14	0.07	5,200	20,438	57.63	1.88									
16	21	3	Running	9:00	24.5	20.3	29.8		29.8	12.1	156	85	0.30	0.015	1,885	2,536	8.95	0.45						90	477	759	2.14	0.07	5,763	22,649	63.86	2.09									
16	21	3	In Failure	15:30	0	20.3	0.0	1.0	-1.0	-0.4	156	85	0.30	0.015	-60	-81	-0.29	-0.01						90	477	759	2.14	0.07	-183	-721	-2.03	-0.07									
16	21	4	Running	9:00	24	19.0	27.4		27.4	11.1	156	85	0.30	0.015	1,728	2,326	8.21	0.41						90	477	759	2.14	0.07	5,284	20,766	58.55	1.92									
16	21	5	Running	9:00	24	21.1	30.4		30.4	12.3	156	85	0.30	0.015	1,919	2,583	9.12	0.46						90	477	759	2.14	0.07	5,868	23,061	65.02	2.13									
16	21	6	Running/end run	10:00	25	21.0	31.5		31.5	12.8	156	85	0.30	0.015	1,989	2,678	9.45	0.47						90	477	759	2.14	0.07	6,083	23,909	67.41	2.21									
16	22	0	Column Start-up	8:00	0	0.0	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
16	22	1	Running	8:00	24	20.4	29.4		29.4	11.9	266	134	0.32	0.14	3,164	3,936	9.40	4.11						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
16	22	2	Running	8:45	24.75	20.1	29.8		29.8	12.1	266	134	0.32	0.14	3,214	4,000	9.55	4.18						90	477	759	2.14	0.07	5,764	22,655	63.88	2.09									
16	22	3	In Failure	8:00	23.25	20.3	28.3		28.3	11.5	266	134	0.32	0.14	3,050	3,795	9.06	3.96						90	477	759	2.14	0.07	5,469	21,494	60.60	1.98									
16	22	3	Sand Cap Replaced	14:30-15:00	0	20.3	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00	94	18,590	24,061	71.53	14.43	90	477	759	2.14	0.07	0	0	0.00	0.00	44,920	176,548	497.8	16.3	104.6	41.4	13.6	14.4	88.6
16	22	4	In Failure	8:30	24	20.4	29.4	1.9	27.5	11.1	266	134	0.32	0.14	2,959	3,682	8.79	3.85						90	477	759	2.14	0.07	5,306	20,854	58.80	1.92									
16	22	5	Running	8:00	23.5	20.0	28.2		28.2	11.4	266	134	0.32	0.14	3,037	3,779	9.02	3.95						90	477	759	2.14	0.07	5,446	21,404	60.35	1.97									
16	22	6	Running	8:00	24	20.1	28.9		28.9	11.7	266	134	0.32	0.14	3,117	3,878	9.26	4.05						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
16	22	7	Running/end run	8:30	24.5	20.3	29.8		29.8	12.1	266	134	0.32	0.14	3,214	3,999	9.55	4.18						90	477	759	2.14	0.07	5,763	22,649	63.86	2.09									
16	23	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	198	128	0.34	0.28	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
16	23	1	Running	10:00	24	20.5	29.5		29.5	12.0	198	128	0.34	0.28	2,366	3,779	10.04	8.27						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
16	23	2	Running	10:00	24	20.4	29.4		29.4	11.9	198	128	0.34	0.28	2,355	3,760	9.99	8.23						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
16	23	3	Running	10:00	24	20.4	29.4		29.4	11.9	198	128	0.34	0.28	2,355	3,760	9.99	8.23						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
16	23	4	Running	10:00	24	20.2	29.1		29.1	11.8	198	128	0.34	0.28	2,332	3,723	9.89	8.14						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
16	23	5	Running	10:00	24	20.3	29.2		29.2	11.8	198	128	0.34	0.28	2,343	3,742	9.94	8.18						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
16	23	6	Running	10:00	24	20.3	29.2		29.2	11.8	198	128	0.34	0.28	2,343	3,742	9.94	8.18						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
16	23	7	Running/end run	10:00	24	20.3	29.2		29.2	11.8	198	128	0.34	0.28	2,343	3,742	9.94	8.18						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
16	24	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
16	24	1	In Failure	10:00	24	20.3	29.2	11.4	17.8	7.2	330	162	0.55	0.32	2,382	2,889	9.81	5.71						90	477	759	2.14	0.07	3,444	13,534	38.16	1.25									
16	24	1	Sand Cap Replaced	11:00-11:30	0	20.3	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00	137	31,147	44,474	116.15	79.15	90	477	759	2.14	0.07	0	0	0.00	0.00	65,148	256,048	721.9	23.6	151.8	47.8	17.4	16.1	335.2
16	24	2	In Failure	10:00	23.5	20.4	28.8	11.4	17.4	7.0	330	162	0.55	0.32	2,320	2,813	9.55	5.56						90	477	759	2.14	0.07	3,353	13,179	37.16	1.22									
16	24	3	In Failure	10:00	24	20.5	29.5	18.9	10.6	4.3	330	162	0.55	0.32	1,419	1,720	5.84	3.40						90	477	759	2.14	0.07	2,051	8,061	22.73	0.74									
16	24	4	In Failure	10:00	24	20.8	30.0	18.9	11.1	4.5	330	162	0.55	0.32	1,477	1,790	6.08	3.54						90	477	759	2.14	0.07	2,134	8,388	23.65	0.77									
16	24	4	1" Media Replaced	13:30-14:00	0	20.8	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00	16	5,215	6,324	21.47	12.49	90	477	759	2.14	0.07	0	0	0.00	0.00	7,539	29,628	83.5	2.7	17.6	69.2	21.3	25.7	457.1
16	24	5	Running	10:00	23.5	21.0	29.6		29.6	12.0	330	162	0.55	0.32	3,956	4,797	16.29	9.48						90	477	759	2.14	0.07	5,718	22,474	63.37	2.07									
16	24	6	Running	10:00	24	20.7	29.8		29.8	12.1	330	162	0.55	0.32	3,982	4,829	16.39	9.54		project end				90	477	759	2.14	0.07	5,756	22,624	63.79	2.09		project end							
16	24	7	Running/end run	10:00	24	20.3	29.2		29.2	11.8	330	162	0.55	0.32	3,905	4,736	16.08	9.35	36	11,844	14,361	48.76	28.37	90	477	759	2.14	0.07	5,645	22,187	62.56	2.05	17,120	67,285	189.7	6.2					
								SUM =	1,251	506			Project totals =		151,562	183,346	419	147	506	151,562	183,346	419	147						241,570	949,432	2,677	88	241,570	949,432	2,677	87.6					

Table B-18. 4-Inch Scale Filter Column Loading Calculations, Column 17, Bayoxide E-33

Bayoxide E-33			Column Status and Filtration Volumes								Average Clarifier Concentration				Calculated Load				Calculated Load at Failure/Activity					"Typical" Tahoe Storm Water Concentrations					Calculated "Typical" Tahoe Load				Calculated "Tahoe" Load at Failure/Activity				Percent of "Typical" Tahoe Storm Water Treated				
Col	Run #	Run Day	Status/Activity	Time	Hours In-Service (hrs)	Average Flowrate (ml/min)	Calc Vol. Filtered (L)	Overflow Adjust (L)	**Volume Filtered (L)**	**Feet Filtered (ft)**	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Total Filter Load (ft)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (ft)	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (% of annual)	Turb (%)	TSS (%)	Tot-P (%)	Dis-P (%)
17	18	0	Column Start-up	8:20	0	0.0	0.0		0.0	0.0	106	44	0.10	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
17	18	1	Running	8:20	24	20.7	29.8		29.8	12.1	106	44	0.10	0.015	1,279	1,312	2.98	0.45						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
17	18	2	Running	8:20	24	20.6	29.7		29.7	12.0	106	44	0.10	0.015	1,273	1,305	2.97	0.44						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
17	18	3	Running	8:20	24	20.1	28.9		28.9	11.7	106	44	0.10	0.015	1,242	1,274	2.89	0.43						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
17	18	4	Running	8:20	24	20.2	29.1		29.1	11.8	106	44	0.10	0.015	1,248	1,280	2.91	0.44						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
17	18	5	Running	8:20	24	20.3	29.2		29.2	11.8	106	44	0.10	0.015	1,254	1,286	2.92	0.44						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
17	18	6	Running	8:20	24	20.7	29.8		29.8	12.1	106	44	0.10	0.015	1,279	1,312	2.98	0.45						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
17	18	7	Running	8:20	24	20.8	30.0		30.0	12.1	106	44	0.10	0.015	1,285	1,318	3.00	0.45						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
17	18	8	Running/end run	8:15	24	20.9	30.1		30.1	12.2	106	44	0.10	0.015	1,292	1,324	3.01	0.45						90	477	759	2.14	0.07	5,812	22,843	64.41	2.11									
17	19	0	Column Start-up	12:00	0	0.0	0.0		0.0	0.0	591	272	0.24	0.015	0	0	0.00	0.00																							
17	19	1	Sand Cap Replaced	8:30-11:00	0	21.0	0.0		0.0	0.0	591	272	0.24	0.015	0	0	0.00	0.00	96	10,153	10,410	23.66	3.55	90	477	759	2.14	0.07	0	0	0.00	0.00	45,690	179,573	506.3	16.6	106.4	22.2	5.8	4.7	21.4
17	19	1	Running	12:00	21.5	21.0	27.1	9.5	17.6	7.1	591	272	0.24	0.015	4,209	4,784	4.22	0.26						90	477	759	2.14	0.07	3,397	13,351	37.64	1.23									
17	19	2	Running	12:00	24	21.2	30.5		30.5	12.4	591	272	0.24	0.015	7,304	8,304	7.33	0.46						90	477	759	2.14	0.07	5,895	23,171	65.33	2.14									
17	19	3	Running	12:00	24	20.7	29.8		29.8	12.1	591	272	0.24	0.015	7,132	8,108	7.15	0.45						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
17	19	4	Running/end run	13:30	25.5	20.3	31.1		31.1	12.6	591	272	0.24	0.015	7,432	8,448	7.45	0.47						90	477	759	2.14	0.07	5,998	23,574	66.47	2.17									
17	20	0	Column Start-up	8:30	0	0.0	0.0		0.0	0.0	627	280	0.58	0.04	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
17	20	1	Running	8:30	24	20.2	29.1		29.1	11.8	627	280	0.58	0.04	7,384	8,145	16.87	1.16						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
17	20	2	Running	8:30	24	19.6	28.2		28.2	11.4	627	280	0.58	0.04	7,165	7,903	16.37	1.13						90	477	759	2.14	0.07	5,451	21,422	60.40	1.98									
17	20	3	Running	8:30	24	19.6	28.2		28.2	11.4	627	280	0.58	0.04	7,165	7,903	16.37	1.13						90	477	759	2.14	0.07	5,451	21,422	60.40	1.98									
17	20	4	Running	8:30	24	19.6	28.2		28.2	11.4	627	280	0.58	0.04	7,165	7,903	16.37	1.13						90	477	759	2.14	0.07	5,451	21,422	60.40	1.98									
17	20	5	Running	8:30	24	19.3	27.8		27.8	11.3	627	280	0.58	0.04	7,055	7,782	16.12	1.11						90	477	759	2.14	0.07	5,367	21,094	59.47	1.95									
17	20	6	Running/end run	9:00	24.5	19.3	28.4		28.4	11.5	627	280	0.58	0.04	7,202	7,944	16.46	1.13						90	477	759	2.14	0.07	5,479	21,534	60.71	1.99									
																								90	477	759	2.14	0.07	0	0	0.00	0.00									
17	21	0	Column Start-up	9:00	0	0.0	0.0		0.0	0.0	156	85	0.30	0.015	0	0	0.00	0.00																							
17	21	1	Running	9:00	24	20.1	28.9		28.9	11.7	156	85	0.30	0.015	1,828	2,460	8.68	0.43						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
17	21	2	Running	9:00	24	20.3	29.2		29.2	11.8	156	85	0.30	0.015	1,846	2,485	8.77	0.44						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
17	21	3	Running	9:00	24	20.8	30.0		30.0	12.1	156	85	0.30	0.015	1,892	2,546	8.99	0.45						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
17	21	4	Running	9:00	24	20.2	29.1		29.1	11.8	156	85	0.30	0.015	1,837	2,472	8.73	0.44						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
17	21	5	In Failure	8:30	23.5	21.0	29.6	3.8	25.8	10.4	156	85	0.30	0.015	1,630	2,194	7.74	0.39						90	477	759	2.14	0.07	4,984	19,590	55.23	1.81									
17	21	5	Sand Cap Replaced	8:30-10:00	0	21.0	0.0		0.0	0.0	156	85	0.30	0.015	0	0	0.00	0.00	171	78,244	89,380	167.62	10.58	90	477	759	2.14	0.07	0	0	0.00	0.00	81,483	320,248	902.9	29.5	189.8	96.0	27.9	18.6	35.8
17	21	6	Running/end run	10:00	24	21.0	30.2		30.2	12.2	156	85	0.30	0.015	1,910	2,570	9.07	0.45						90	477	759	2.14	0.07	5,840	22,952	64.71	2.12									
17	22	0	Column Start-up	8:00	0	0.0	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
17	22	1	Running	8:00	24	20.2	29.1		29.1	11.8	266	134	0.32	0.14	3,133	3,898	9.31	4.07						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
17	22	2	Running	8:00	24	20.1	28.9		28.9	11.7	266	134	0.32	0.14	3,117	3,878	9.26	4.05						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
17	22	3	Running	8:00	24	20.6	29.7		29.7	12.0	266	134	0.32	0.14	3,195	3,975	9.49	4.15						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
17	22	4	Running	8:00	24	20.7	29.8		29.8	12.1	266	134	0.32	0.14	3,210	3,994	9.54	4.17						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
17	22	5	Running	8:00	24	20.0	28.8		28.8	11.7	266	134	0.32	0.14	3,102	3,859	9.22	4.03						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
17	22	6	Running	8:00	24	20.0	28.8		28.8	11.7	266	134	0.32	0.14	3,102	3,859	9.22	4.03						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
17	22	7	Running/end run	8:30	24.5	20.0	29.4		29.4	11.9	266	134	0.32	0.14	3,166	3,940	9.41	4.12						90	477	759	2.14	0.07	5,678	22,315	62.92	2.06									
17	23	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	198	128	0.34	0.28	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
17	23	1	Running	10:00	24	20.6	29.7		29.7	12.0	198	128	0.34	0.28	2,378	3,797	10.09	8.31						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
17	23	2	Running	10:00	24	20.6	29.7		29.7	12.0	198	128	0.34	0.28	2,378	3,797	10.09	8.31						90	477	759	2.14	0.07	5,729	22,515	63.48	2.08									
17	23	3	Running	10:00	24	20.7	29.8		29.8	12.1	198	128	0.34	0.28	2,389	3,815	10.13	8.35						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
17	23	4	Running	10:00	24	20.8	30.0		30.0	12.1	198	128	0.34	0.28	2,401	3,834	10.18	8.39						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
17	23	5	Running	10:00	24	20.5	29.5		29.5	12.0	198	128	0.34	0.28	2,366	3,779	10.04	8.27						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
17	23	6	Running	10:00	24	20.1	28.9		28.9	11.7	198	128	0.34	0.28	2,320	3,705	9.84	8.10						90	477	759	2.14	0.07	5,590	21,968	61.94	2.03									
17	23	7	In Failure	10:00	24	20.0	28.8	1.0	27.9	11.3	198	128	0.34	0.28	2,233	3,565	9.47	7.80						90	477	759	2.14	0.07	5,378	21,138	59.60	1.95									
17	24	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
17	24	1	In Failure	10:00	24	20.2	29.1	15.1	14.0	5.7	330	162	0.55	0.32	1,869	2,266	7.69	4.48						90	477	759	2.14	0.07	2,701	10,617	29.93	0.98									
17	24	1	Sand Cap Replaced	10:45-11:15	0	20.2	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00	184	42,268	58,531	152.04	91.07	90	477	759	2.14	0.07	0	0	0.00	0.00	87,701	344,688	971.8	31.8	204.3	48.2	17.0	15.6	286.5
17	24	2	In Failure	10:00	23.5	20.1	28.3	11.4	16.9	6.9	330	162	0.55	0.32	2,263	2,744	9.32	5.42						90	477	759	2.14	0.07	3,272	12,858	36.25	1.19									
17	24	3	In Failure	10:00	24	20.4	29.4	18.9	10.5	4.2	330	162	0.55	0.32	1,400	1,697	5.76	3.35						90	477	759	2.14	0.07	2,023	7,951	22.42	0.73									
17	24	4	Running	10:00	24	20.8	30.0		30.0	12.1	330	162	0.55	0.32	4,002	4,852	16.47	9.58						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
17	24	5	Running	10:00	24	20.7	29.8		29.8	12.1	330	162	0.55	0.32	3,982	4,829	16.39	9.54						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
17	24	6	Running	10:00	24	20.2	29.1		29.1	11.8	330	162	0.55	0.32	3,886	4,712	16.00	9.31		end of project				90	477	759	2.14	0.07	5,617	22,078	62.25	2.04		end of project							
17	24	7	Running/end run	10:00	24	20.0	28.8		28.8	11.7	330	162	0.55	0.32	3,848	4,666	15.84	9.22	59	19,381	23,501	79.79	46.42	90	477	759	2.14	0.07	5,562	21,859	61.63	2.02	28,015	110,104	310.4	10.2					
								SUM =	1,258	509			Project totals =		150,047	181,822	423	152	509	150,047	181,822	423	152						242,889	954,613	2,692	88.0	242,889	954,613	2,692	88.0					

Table B-19. 4-Inch Scale Filter Column Loading Calculations, Column 18, Bayoxide E-33

Bayoxide E-33

Column Status and Filtration Volumes											Average Clarifier Concentration				Calculated Load				Calculated Load at Failure/Activity					"Typical" Tahoe Storm Water Concentrations					Calculated "Typical" Tahoe Load				Calculated "Tahoe" Load at Failure/Activity				Percent of "Typical" Tahoe Storm Water Treated				
Col	Run #	Run Day	Status/Activity	Time	Hours In-Service (hrs)	Average Flowrate (ml/min)	Calc Vol. Filtered (L)	Overflow Adjust (L)	**Volume Filtered (L)**	**Feet Filtered (ft)**	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Total Filter Load (ft)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (ft)	Turb (NTU)	TSS (mg/L)	Tot-P (mg/L)	Dis-P (mg/L)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Turb (NTU-ft)	TSS (mg)	Tot-P (mg)	Dis-P (mg)	Filter Load (% of annual)	Turb (%)	TSS (%)	Tot-P (%)	Dis-P (%)
18	18	0	Column Start-up	8:20	0	0.0	0.0		0.0	0.0	106	44	0.10	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
18	18	1	Running	8:20	24	20.8	30.0		30.0	12.1	106	44	0.10	0.015	1,285	1,318	3.00	0.45						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
18	18	2	Running	8:20	24	20.4	29.4		29.4	11.9	106	44	0.10	0.015	1,261	1,293	2.94	0.44						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
18	18	3	Running	8:20	24	20.4	29.4		29.4	11.9	106	44	0.10	0.015	1,261	1,293	2.94	0.44						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
18	18	4	Running	8:20	24	20.7	29.8		29.8	12.1	106	44	0.10	0.015	1,279	1,312	2.98	0.45						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
18	18	5	Running	8:20	24	20.2	29.1		29.1	11.8	106	44	0.10	0.015	1,248	1,280	2.91	0.44						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
18	18	6	Running	8:20	24	20.4	29.4		29.4	11.9	106	44	0.10	0.015	1,261	1,293	2.94	0.44						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
18	18	7	Running	8:20	24	20.8	30.0		30.0	12.1	106	44	0.10	0.015	1,285	1,318	3.00	0.45						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
18	18	8	In Failure	8:15	24	20.7	29.8	6.9	22.9	9.3	106	44	0.10	0.015	983	1,008	2.29	0.34						90	477	759	2.14	0.07	4,424	17,387	49.02	1.60									
18	19	0	Sand Cap Replaced	10:00-11:00	--	--	--		--	-									93	9,863	10,113	22.98	3.45										44,385	174,446	491.8	16.1	103.4	22.2	5.8	4.7	21.4
18	19	0	Column Start-up	12:00	0	0.0	0.0		0.0	0.0	591	272	0.24	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
18	19	1	Running	12:00	24	20.3	29.2		29.2	11.8	591	272	0.24	0.015	6,994	7,951	7.02	0.44						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
18	19	2	Running	12:00	24	20.3	29.2		29.2	11.8	591	272	0.24	0.015	6,994	7,951	7.02	0.44						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
18	19	3	Running	12:00	24	20.9	30.1		30.1	12.2	591	272	0.24	0.015	7,201	8,186	7.22	0.45						90	477	759	2.14	0.07	5,812	22,843	64.41	2.11									
18	19	4	Running/end run	13:30	25.5	21.3	32.6		32.6	13.2	591	272	0.24	0.015	7,798	8,864	7.82	0.49						90	477	759	2.14	0.07	6,294	24,735	69.74	2.28									
18	20	0	Column Start-up	8:30	0	0.0	0.0		0.0	0.0	627	280	0.58	0.04	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
18	20	1	Running	8:30	24	20.2	29.1		29.1	11.8	627	280	0.58	0.04	7,384	8,145	16.87	1.16						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
18	20	2	Running	8:30	24	19.8	28.5		28.5	11.5	627	280	0.58	0.04	7,238	7,983	16.54	1.14						90	477	759	2.14	0.07	5,506	21,641	61.02	2.00									
18	20	3	Running	8:30	24	20.4	29.4		29.4	11.9	627	280	0.58	0.04	7,457	8,225	17.04	1.18						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
18	20	4	Running	8:30	24	20.3	29.2		29.2	11.8	627	280	0.58	0.04	7,420	8,185	16.95	1.17						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
18	20	5	Running	8:30	24	20.0	28.8		28.8	11.7	627	280	0.58	0.04	7,311	8,064	16.70	1.15						90	477	759	2.14	0.07	5,562	21,859	61.63	2.02									
18	20	6	Running/end run	9:00	24.5	20.0	29.4		29.4	11.9	627	280	0.58	0.04	7,463	8,232	17.05	1.18						90	477	759	2.14	0.07	5,678	22,315	62.92	2.06									
18	21	0	Column Start-up	9:00	0	0.0	0.0		0.0	0.0	156	85	0.30	0.015	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
18	21	1	In Failure	9:00	24	20.9	30.1		30.1	12.2	156	85	0.30	0.015	1,901	2,558	9.03	0.45						90	477	759	2.14	0.07	5,812	22,843	64.41	2.11									
18	21	1	Sand Cap Replaced	10:30-11:30	0	20.9	0.0		0.0	0.0	156	85	0.30	0.015	0	0	0.00	0.00	132	75,161	84,345	139.26	9.24	90	477	759	2.14	0.07	0	0	0.00	0.00	62,889	247,171	696.9	22.8	146.5	119.5	34.1	20.0	40.6
18	21	2	Running	9:00	23	20.7	28.6		28.6	11.6	156	85	0.30	0.015	1,804	2,428	8.57	0.43						90	477	759	2.14	0.07	5,517	21,682	61.13	2.00									
18	21	3	Running	9:00	24	20.2	29.1		29.1	11.8	156	85	0.30	0.015	1,837	2,472	8.73	0.44						90	477	759	2.14	0.07	5,617	22,078	62.25	2.04									
18	21	4	Running	9:00	24	20.5	29.5		29.5	12.0	156	85	0.30	0.015	1,864	2,509	8.86	0.44						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
18	21	5	Running	9:00	24	19.8	28.5		28.5	11.5	156	85	0.30	0.015	1,801	2,424	8.55	0.43						90	477	759	2.14	0.07	5,506	21,641	61.02	2.00									
18	21	6	Running/end run	10:00	25	20.0	30.0		30.0	12.1	156	85	0.30	0.015	1,895	2,550	9.00	0.45						90	477	759	2.14	0.07	5,794	22,770	64.20	2.10									
18	22	0	Column Start-up	8:00	0	0.0	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
18	22	0	Sand Cap Replaced	17:00-18:00	0	0.0	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00	59	9,201	12,383	43.71	2.19	90	477	759	2.14	0.07	0	0	0.00	0.00	28,135	110,576	311.8	10.2	65.5	32.7	11.2	14.0	21.4
18	22	1	In Failure	8:00	23	20.6	28.4	5.7	22.7	9.2	266	134	0.32	0.14	2,448	3,046	7.27	3.18						90	477	759	2.14	0.07	4,389	17,251	48.64	1.59									
18	22	1	2" Media Replaced	10:00-12:00	0	20.6	0.0		0.0	0.0	266	134	0.32	0.14	0	0	0.00	0.00	9	2,448	3,046	7.27	3.18	90	477	759	2.14	0.07	0	0	0.00	0.00	4,389	17,251	48.6	1.6	10.2	55.8	17.7	15.0	200.0
18	22	2	Running	8:00	22	20.6	27.2		27.2	11.0	266	134	0.32	0.14	2,928	3,644	8.70	3.81						90	477	759	2.14	0.07	5,251	20,639	58.19	1.90									
18	22	3	Running	8:00	24	20.8	30.0		30.0	12.1	266	134	0.32	0.14	3,226	4,014	9.58	4.19						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
18	22	4	Running	8:00	24	20.7	29.8		29.8	12.1	266	134	0.32	0.14	3,210	3,994	9.54	4.17						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
18	22	5	Running	8:00	24	20.3	29.2		29.2	11.8	266	134	0.32	0.14	3,148	3,917	9.35	4.09						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
18	22	6	Running	8:00	24	21.0	30.2		30.2	12.2	266	134	0.32	0.14	3,257	4,052	9.68	4.23						90	477	759	2.14	0.07	5,840	22,952	64.71	2.12									
18	22	7	Running/end run	8:30	24.5	21.0	30.9		30.9	12.5	266	134	0.32	0.14	3,324	4,137	9.88	4.32						90	477	759	2.14	0.07	5,962	23,430	66.06	2.16									
18	23	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	198	128	0.34	0.28	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
18	23	1	Running	10:00	24	20.5	29.5		29.5	12.0	198	128	0.34	0.28	2,366	3,779	10.04	8.27						90	477	759	2.14	0.07	5,701	22,406	63.17	2.07									
18	23	2	Running	10:00	24	21.0	30.2		30.2	12.2	198	128	0.34	0.28	2,424	3,871	10.28	8.47						90	477	759	2.14	0.07	5,840	22,952	64.71	2.12									
18	23	3	Running	10:00	24	20.7	29.8		29.8	12.1	198	128	0.34	0.28	2,389	3,815	10.13	8.35						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
18	23	4	Running	10:00	24	20.7	29.8		29.8	12.1	198	128	0.34	0.28	2,389	3,815	10.13	8.35						90	477	759	2.14	0.07	5,756	22,624	63.79	2.09									
18	23	5	Running	10:00	24	20.8	30.0		30.0	12.1	198	128	0.34	0.28	2,401	3,834	10.18	8.39						90	477	759	2.14	0.07	5,784	22,734	64.10	2.10									
18	23	6	Running	10:00	24	20.4	29.4		29.4	11.9	198	128	0.34	0.28	2,355	3,760	9.99	8.23						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
18	23	7	Running/end run	10:00	24	20.3	29.2		29.2	11.8	198	128	0.34	0.28	2,343	3,742	9.94	8.18						90	477	759	2.14	0.07	5,645	22,187	62.56	2.05									
18	24	0	Column Start-up	10:00	0	0.0	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00						90	477	759	2.14	0.07	0	0	0.00	0.00									
18	24	1	In Failure	10:00	24	20.5	29.5	9.5	20.0	8.1	330	162	0.55	0.32	2,675	3,243	11.01	6.41						90	477	759	2.14	0.07	3,866	15,195	42.84	1.40									
18	24	1	Sand Cap Replaced	10:15-10:45	0	20.5	0.0		0.0	0.0	330	162	0.55	0.32	0	0	0.00	0.00	164	38,436	53,616	138.44	89.45	90	477	759	2.14	0.07	0	0	0.00	0.00	78,261	307,585	867.2	28.4	182.3	49.1	17.4	16.0	315.3
18	24	2	Running	10:00	23.5	20.3	28.6		28.6	11.6	330	162	0.55	0.32	3,824	4,637	15.74	9.16						90	477	759	2.14	0.07	5,528	21,725	61.25	2.00									
18	24	3	Running	10:00	24	20.4	29.4		29.4	11.9	330	162	0.55	0.32	3,925	4,759	16.16	9.40						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
18	24	4	Running	10:00	24	20.4	29.4		29.4	11.9	330	162	0.55	0.32	3,925	4,759	16.16	9.40						90	477	759	2.14	0.07	5,673	22,296	62.86	2.06									
18	24	5	Running	10:00	24	21.0	30.2		30.2	12.2	330	162	0.55	0.32	4,040	4,899	16.63	9.68						90	477	759	2.14	0.07	5,840	22,952	64.71	2.12									
18	24	6	Running	10:00	24	20.8	30.0		30.0	12.1	330	162	0.55	0.32	4,002	4,852	16.47	9.58		end of project				90	477	759	2.14	0.07	5,784	22,734	64.10	2.10		end of project							
18	24	7	Running/end run	10:00	24	20.6	29.7		29.7	12.0	330	162	0.55	0.32	3,963	4,806	16.32	9.49	72	23,679	28,711	97.48	56.71	90	477	759	2.14	0.07	5,729	22,515	63.48	2.08	34,226	134,518	379.3	12.4					
								SUM =	1,306	529			Project totals =		158,788	192,214	449	164	529	158,788	192,214	449	164						252,285	991,545	2,796	91.4	252,285	991,545	2,796	91.4					

Table B-20. 4-Inch Filter Column Effluent Data

4-Inch Column Effluent Samples										
Unit	**Parameter**	**Units**	**RUN 17A**	**RUN 18**	**RUN 19**	**RUN 20**	**RUN 21**	**RUN 22**	**RUN 23**	**RUN 24**
Initial Baker										
Initial Baker										
Initial Baker	Influent Collected	(date)				11-Mar-05	19-Mar-05			
Initial Baker	Date Sampled	(date)	Not Collected	Not Collected	Not Collected	11-Mar-05	19-Mar-05	Not Collected	Not Collected	Not Collected
Initial Baker	Pilot Log #	(#)				Initial-B	21-BK+N-1			
Initial Baker	Lab ID #	(#)				0503235-01	0503480-01			
Initial Baker	Phosphorus - dissolved	mg-P/L				< 0.03	0.03			
Initial Baker	Phosphorus - total	mg-P/L				1.20	0.39			
Initial Baker										
Baker										
	Sample	-	Baker	Baker	Baker	Baker	Baker	Baker	Baker	Baker
Tank	Influent Collected	(date)	12-Nov-04	9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
(influent)	Date Sampled	(date)	13-Nov-04	10-Dec-04	17-Dec-04	12-Mar-05	19-Mar-05	23-Apr-05	30-Apr-05	15-May-05
	Pilot Log #	(#)	17A-Baker-1	18-Baker-1	18-Baker-1	20-BK	21-BK+N	22-BAKER	23-BK	24-BK (N)
Baker	Lab ID #	(#)	0411355-01	0412374-01	0412411-01	0503278-01	0503481-01	0504410-01	0505057-1	0505337-01
Baker	pH (field)	S.U.	7.2	7.2	7.4	7.3	7.4	7.5	7.4	8.1
Baker	EC (field)	µS	4,844	2,037	1,900	3,022	636	3,616	556	440
Baker	Turbidity (field)	NTU	165	187	845	1758	267	385	285	390
Baker	Temperature (field)	°C	6.5	5.5	9.5	7.1	6.3	13.3	10.6	13.8
Baker	Acid Soluble Aluminum	µg/L	690	347	1,160	322	109	200	147	184
Baker	Aluminum - total	µg/L	2,792	3,496	8,350	18,370	4,693	6,648	6,161	6,279
Baker	Iron - total	µg/L	4,820	5,550	15,700	34,600	6,030	8,940	8,840	8,680
Baker	Aluminum - dissolved	µg/L	< 25	< 25	< 25	< 25	< 25	< 25	28	< 25
Baker	Iron - dissolved	µg/L	25	87	< 25	37	157	49	172	< 25
Baker	Alkalinity - total	mg-$CaCO_3$/L	26	24	38	40	34	28	56	20
Baker	Phosphorus - dissolved	mg-P/L	< 0.03	0.05	< 0.03	0.08	0.03	0.08	0.20	0.33
Baker	Kjeldahl Nitrogen - total	mg-N/L	0.39	1.90	1.75	2.11	0.27	0.96	0.57	0.85
Baker	Kjeldahl Nitrogen - dissolved	mg-N/L	0.19	1.06	J g < 0.10	< 0.10	0.17	< 0.10	0.52	0.16
Baker	Total Organic Carbon	mg/L	9.5	20.4	U m 7.7	5.4	18.5	J g 5.5	U m 4.5	3.7
Baker	Phosphorus - total	mg-P/L	0.12	0.13	0.51	1.24	0.47	0.61	0.48	0.64
Baker	Total Suspended Solids	mg/L	112	J a 144	588	906	262	261	377	321
Baker	Volatile Suspended Solids	mg/L	31	J a 50	56	711	201	52	71	58
Baker	Nitrate + Nitrite	mg-N/L	0.24	0.20	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Baker	Total Nitrogen (calculated)	mg-N/L	0.63	2.10	1.75	2.11	0.27	J g 0.96	0.57	0.85
TOC-QC	Influent Collected	(date)	12-Nov-04	9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
	Date Sampled	(date)	13-Nov-04	10-Dec-04	17-Dec-04	12-Mar-05	19-Mar-05	23-Apr-05	30-Apr-05	15-May-05
Dup or	Pilot Log #	(#)	17A-Baker-2	18-Baker-2	19-Baker-2	21-BKT	21-BKT+N	22-BKT	23-BKT	24-BKT (N)
Blank	Lab ID #	(#)	0411354-01	0412375-01	0412410-01	0503277-01	0503482-01	0504410-01	0505056-01	0505338-01
	Blank or Dup	Blk/Dup	Btl Blk	Btl Blk	Btl Blk	Dup	Dup	Dup	Btl Blk	Dup
TOC-QC	Total Organic Carbon	mg/L	1.3	2.0	1.7	5.4	17.3	9.5	1.3	3.5

Table B-20 (Continued). 4-Inch Filter Column Effluent Data

Unit	Parameter	Units	RUN 17A	RUN 18	RUN 19	RUN 20	RUN 21	RUN 22	RUN 23	RUN 24
1	Filter Media	(desc.)	Existing AA	Existing AA	Existing AA	Existing AA	Existing AA	Existing AA	Existing AA	Existing AA
1	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
1	Flow Started	(date)	Column not run	11-Dec-04	19-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
1	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
1	Pilot Log #	(#)		18-1E	19-1E	20-1E	21-1E	22-1E	23-1E	24-1E
1	Lab ID #	(#)		0412359-1	0412458-01	0503354-01	0503562-01	0504451-01	0505152-01	0505395-01
1	pH (field)	S.U.		7.8	7.5	7.8	7.7	8.0	7.9	8.0
1	EC (field)	µS		2,094	1,862	2,564	610	3,661	587	468
1	Turbidity (field)	NTU		0.4	12.3	0.9	16.3	0.9	22.3	0.8
1	Temperature (field)	°C		13.7	13.9	8.5	10.4	12.6	12.6	12.3
1	Acid Soluble Aluminum	µg/L		< 25	50	28	178	< 25	55	< 25
1	Aluminum - total	µg/L		< 25	128	33	388	< 25	620	< 25
1	Aluminum - dissolved	µg/L		< 25	< 25	27	< 25	< 25	36	< 25
1	Alkalinity - total	mg-CaCO$_3$/L		74	52	48	25	54	31	46
1	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	0.06	0.11	< 0.03	< 0.03
1	Kjeldahl Nitrogen - total	mg-N/L		0.27	0.29	< 0.10	0.23	J g 0.18	< 0.10	0.77
1	Kjeldahl Nitrogen - dissolved	mg-N/L		0.20	J g 0.28	< 0.10	0.19	< 0.10	< 0.10	< 0.10
1	Phosphorus - total	mg-P/L		< 0.03	< 0.03	< 0.03	0.04	0.11	< 0.03	< 0.03
1	Total Suspended Solids	mg/L		J a 6	1	< 1	6	3	< 1	< 1
1	Nitrate + Nitrite	mg-N/L		0.12	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
1	Total Nitrogen (calculated)	mg-N/L		0.39	0.29	< 0.10	0.23	J g 0.18	< 0.10	0.77
2	Filter Media	(desc.)	Existing AA	Existing AA	Existing AA	Existing AA	Existing AA	Existing AA	Existing AA	Existing AA
2	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
2	Flow Started	(date)	Column not run	11-Dec-04	19-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
2	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
2	Pilot Log #	(#)		18-2E	19-2E	20-2E	21-2E	22-2E	23-2E	24-2E
2	Lab ID #	(#)		0412360-1	0412430-01	0503351-01	0503561-01	0505022-01	0505153-01	0505396-01
2	pH (field)	S.U.		7.8	7.5	7.4	7.7	8.1	7.9	8.3
2	EC (field)	µS		2,090	1,863	3,009	617	3,651	598	507
2	Turbidity (field)	NTU		0.3	8.0	1.4	15.4	0.7	19.7	1.0
2	Temperature (field)	°C		13.7	13.7	9.0	10.3	12.6	12.6	12.2
2	Acid Soluble Aluminum	µg/L		< 25	109	37	148	< 25	47	< 25
2	Aluminum - total	µg/L		< 25	183	52	417	< 25	580	< 25
2	Aluminum - dissolved	µg/L		< 25	< 25	< 25	< 25	< 25	< 25	< 25
2	Alkalinity - total	mg-CaCO$_3$/L		64	46	44	25	< 1	31	40
2	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
2	Kjeldahl Nitrogen - total	mg-N/L		0.29	0.23	< 0.10	0.36	J g < 0.10	< 0.10	0.58
2	Kjeldahl Nitrogen - dissolved	mg-N/L		< 0.10	J g 0.17	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
2	Phosphorus - total	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
2	Total Suspended Solids	mg/L		J a 34	4	4	4	J a < 1	< 1	< 1
2	Nitrate + Nitrite	mg-N/L		0.13	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
2	Total Nitrogen (calculated)	mg-N/L		0.42	0.23	< 0.10	0.36	J g < 0.10	< 0.10	0.58

Table B-20 (Continued). 4-Inch Filter Column Effluent Data

Unit	Parameter	Units	RUN 17A	RUN 18	RUN 19	RUN 20	RUN 21	RUN 22	RUN 23	RUN 24
3	Filter Media	(desc.)	Existing Sand	Existing Sand	Existing Sand	Existing Sand	Existing Sand	Existing Sand	Existing Sand	Existing Sand
3	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
3	Flow Started	(date)	Column not run	11-Dec-04	19-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
3	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
3	Pilot Log #	(#)		18-3E	19-3E	20-3E	21-3E	22-3E	23-3E	24-3E
3	Lab ID #	(#)		0412361-1	0412444-01	0503349-01	0503532-01	0505020-01	0505155-01	0505400-01
3	pH (field)	S.U.		7.0	7.2	7.4	7.2	7.4	7.4	7.4
3	EC (field)	µS		2,055	1,858	3,009	626	3,640	621	417
3	Turbidity (field)	NTU		27.3	116	139	35	42	47	172
3	Temperature (field)	°C		14.0	13.6	9.0	9.8	12.6	12.6	12.2
3	Acid Soluble Aluminum	µg/L		75	272	348	614	< 25	157	161
3	Aluminum - total	µg/L		620	1,322	22,222	921	769	1,065	3,991
3	Aluminum - dissolved	µg/L		< 25	< 25	< 25	< 25	< 25	< 25	< 25
3	Alkalinity - total	mg-$CaCO_3$/L		28	26	36	35	36	57	18
3	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.16	0.24	0.30
3	Kjeldahl Nitrogen - total	mg-N/L		0.39	0.46	0.51	0.35	J g < 0.10	0.10	0.20
3	Kjeldahl Nitrogen - dissolved	mg-N/L		0.29	J g 0.32	0.46	0.30	< 0.10	< 0.10	< 0.10
3	Phosphorus - total	mg-P/L		< 0.03	0.03	0.12	0.05	0.19	0.26	0.40
3	Total Suspended Solids	mg/L		J a 14	37	55	9	J a 10	9	48
3	Nitrate + Nitrite	mg-N/L		0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
3	Total Nitrogen (calculated)	mg-N/L		0.49	0.46	0.51	0.35	J g < 0.10	0.10	0.20
4	Filter Media	(desc.)	Existing Sand	Existing Sand	Existing Sand	Existing Sand	Existing Sand	Existing Sand	Existing Sand	Existing Sand
4	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
4	Flow Started	(date)	Column not run	11-Dec-04	19-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
4	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
4	Pilot Log #	(#)		18-4E	19-4E	20-4E	21-4E	22-4E	23-4E	24-4E
4	Lab ID #	(#)		0412299-01	0412456-01	0503363-01	0503534-01	0505021-01	0505156-01	0505401-01
4	pH (field)	S.U.		7.1	7.1	7.4	7.2	7.4	7.4	7.7
4	EC (field)	µS		2,053	1,870	3,004	632	3,642	599	426
4	Turbidity (field)	NTU		23.9	112	137	34	40	50	180
4	Temperature (field)	°C		13.8	13.7	9.0	10.2	12.6	12.5	12.1
4	Acid Soluble Aluminum	µg/L		100	377	362	311	< 25	164	83
4	Aluminum - total	µg/L		332	1,087	2,944	822	870	1,077	3,782
4	Aluminum - dissolved	µg/L		66	< 25	< 25	< 25	< 25	< 25	< 25
4	Alkalinity - total	mg-$CaCO_3$/L		26	46	36	35	30	56	18
4	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.16	0.25	0.31
4	Kjeldahl Nitrogen - total	mg-N/L		0.32	0.47	0.44	0.48	J g < 0.10	< 0.10	0.28
4	Kjeldahl Nitrogen - dissolved	mg-N/L		< 0.10	J g 0.17	0.27	0.37	< 0.10	< 0.10	0.21
4	Phosphorus - total	mg-P/L		< 0.03	0.04	0.07	0.03	0.18	0.27	0.44
4	Total Suspended Solids	mg/L		8	8	30	8	J a 8	10	37
4	Nitrate + Nitrite	mg-N/L		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
4	Total Nitrogen (calculated)	mg-N/L		0.32	0.47	0.44	0.48	J g < 0.10	< 0.10	0.28

Table B-20 (Continued). 4-Inch Filter Column Effluent Data

Unit	Parameter	Units	RUN 17A	RUN 18	RUN 19	RUN 20	RUN 21	RUN 22	RUN 23	RUN 24
5	Filter Media	(desc.)	AA (28/48)	AA (28/48)	AA (28/48)	AA (28/48)	AA (28/48)	AA (28/48)	AA (28/48)	AA (28/48)
5	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
5	Flow Started	(date)	Column not run	11-Dec-04	19-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
5	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
5	Pilot Log #	(#)		18-5E	19-5E	20-5E	21-5E	22-5E	23-5E	24-5E
5	Lab ID #	(#)		0412362-1	0412457-01	0503355-01	0503535-01	0504446-01	0505163-01	0505414-01
5	pH (field)	S.U.		7.9	7.3	7.9	7.8	8.1	8.0	8.4
5	EC (field)	μS		1,980	1,858	2,987	621	3,668	575	469
5	Turbidity (field)	NTU		0.3	24.4	32.6	14.6	1.2	31.2	1.0
5	Temperature (field)	°C		13.9	13.7	8.9	10.4	12.6	12.7	12.2
5	Acid Soluble Aluminum	μg/L		114	33	160	157	48	75	< 25
5	Aluminum - total	μg/L		135	193	699	343	70	781	46
5	Aluminum - dissolved	μg/L		134	31	38	30	36	51	42
5	Alkalinity - total	mg-$CaCO_3$/L		34	32	36	33	56	37	52
5	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.10	< 0.03	< 0.03
5	Kjeldahl Nitrogen - total	mg-N/L		0.38	0.28	< 0.10	0.33	J g 0.10	< 0.10	0.69
5	Kjeldahl Nitrogen - dissolved	mg-N/L		0.18	J g 0.12	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
5	Phosphorus - total	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.11	< 0.03	< 0.03
5	Total Suspended Solids	mg/L		J a 10	4	11	4	4	3	< 1
5	Nitrate + Nitrite	mg-N/L		0.13	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
5	Total Nitrogen (calculated)	mg-N/L		0.51	0.28	< 0.10	0.33	J g 0.10	< 0.10	0.69
6	Filter Media	(desc.)	AA (28/48)	AA (28/48)	AA (28/48)	AA (28/48)	AA (28/48)	AA (28/48)	AA (28/48)	AA (28/48)
6	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
6	Flow Started	(date)	Column not run	11-Dec-04	19-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
6	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
6	Pilot Log #	(#)		18-6E	19-6E	20-6E	21-6E	22-6E	23-6E	24-6E
6	Lab ID #	(#)		0412363-1	0412449-01	0503352-01	0503533-01	0504449-01	0505164-01	0505407-01
6	pH (field)	S.U.		8.0	7.3	7.9	7.8	8.1	7.9	8.1
6	EC (field)	μS		1,978	1,880	2,993	622	3,668	574	469
6	Turbidity (field)	NTU		0.2	2.6	25.1	13.8	0.7	25.2	0.8
6	Temperature (field)	°C		13.8	13.7	8.9	10.5	12.6	12.7	12.2
6	Acid Soluble Aluminum	μg/L		125	59	114	176	37	67	< 25
6	Aluminum - total	μg/L		138	59	494	326	59	820	43
6	Aluminum - dissolved	μg/L		137	28	40	31	37	79	40
6	Alkalinity - total	mg-$CaCO_3$/L		40	13	38	34	62	43	48
6	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.09	< 0.03	< 0.03
6	Kjeldahl Nitrogen - total	mg-N/L		0.39	0.35	0.15	< 0.10	J g < 0.10	< 0.10	0.49
6	Kjeldahl Nitrogen - dissolved	mg-N/L		0.15	J g 0.30	0.28	< 0.10	< 0.10	< 0.10	< 0.10
6	Phosphorus - total	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.09	< 0.03	< 0.03
6	Total Suspended Solids	mg/L		J a 2	4	10	< 1	5	4	< 1
6	Nitrate + Nitrite	mg-N/L		0.12	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
6	Total Nitrogen (calculated)	mg-N/L		0.51	0.35	0.15	< 0.10	J g < 0.10	< 0.10	0.49

Table B-20 (Continued). 4-Inch Filter Column Effluent Data

Unit	Parameter	Units	RUN 17A	RUN 18	RUN 19	RUN 20	RUN 21	RUN 22	RUN 23	RUN 24
7	Filter Media	(desc.)	AA (14/28)	AA (14/28)	AA (14/28)	AA (14/28)	AA (14/28)	AA (14/28)	AA (14/28)	AA (14/28)
7	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
7	Flow Started	(date)	Column not run	11-Dec-04	19-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
7	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
7	Pilot Log #	(#)		18-7E	19-7E	20-7E	21-7E	22-7E	23-7E	24-7E
7	Lab ID #	(#)		0412300-01	0412443-01	0503346-01	0503560-01	0504470-01	0505165-01	0505415-01
7	pH (field)	S.U.		8.1	6.8	8.0	7.9	8.2	8.0	8.4
7	EC (field)	µS		1,977	1,865	2,984	624	3,663	573	479
7	Turbidity (field)	NTU		1.5	95.9	87.8	22.1	8.3	51.8	12.3
7	Temperature (field)	°C		13.7	13.8	8.9	10.6	12.6	12.7	12.3
7	Acid Soluble Aluminum	µg/L		170	232	298	226	168	104	< 25
7	Aluminum - total	µg/L		205	1,023	1,567	496	183	1,810	244
7	Aluminum - dissolved	µg/L		186	< 25	46	42	53	84	53
7	Alkalinity - total	mg-$CaCO_3$/L		22	6	30	32	52	40	52
7	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	0.03	0.08	< 0.03	< 0.03
7	Kjeldahl Nitrogen - total	mg-N/L		< 0.10	0.35	0.23	0.54	J g < 0.10	< 0.10	0.34
7	Kjeldahl Nitrogen - dissolved	mg-N/L		< 0.10	J g 0.27	0.15	0.35	< 0.10	< 0.10	< 0.10
7	Phosphorus - total	mg-P/L		< 0.03	0.03	0.08	< 0.03	0.10	< 0.03	< 0.03
7	Total Suspended Solids	mg/L		< 1	19	36	7	4	8	2
7	Nitrate + Nitrite	mg-N/L		0.12	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
7	Total Nitrogen (calculated)	mg-N/L		0.12	0.35	0.23	0.54	J g < 0.10	< 0.10	0.34
8	Filter Media	(desc.)	AA (14/28)	AA (14/28)	AA (14/28)	AA (14/28)	AA (14/28)	AA (14/28)	AA (14/28)	AA (14/28)
8	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
8	Flow Started	(date)	Column not run	11-Dec-04	19-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
8	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
8	Pilot Log #	(#)		18-8E	19-8E	20-8E	21-8E	22-8E	23-8E	24-8E
8	Lab ID #	(#)		0412294-1	0412435-01	0503362-01	0503536-01	0504461-01	0505159-01	0505405-01
8	pH (field)	S.U.		8.1	6.8	8.0	7.8	8.2	8.1	8.5
8	EC (field)	µS		1,990	1,875	2,990	621	3,672	575	484
8	Turbidity (field)	NTU		1.1	57.9	84.7	28.0	7.7	45.6	12.5
8	Temperature (field)	°C		13.6	13.8	8.8	10.5	12.6	12.6	41.3
8	Acid Soluble Aluminum	µg/L		180	170	263	225	123	81	< 25
8	Aluminum - total	µg/L		201	855	1,774	631	151	1,100	931
8	Aluminum - dissolved	µg/L		182	< 25	43	36	44	52	48
8	Alkalinity - total	mg-$CaCO_3$/L		< 1	< 1	28	33	56	39	60
8	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.10	< 0.03	< 0.03
8	Kjeldahl Nitrogen - total	mg-N/L		0.37	0.40	0.23	0.31	J g 0.20	< 0.10	< 0.10
8	Kjeldahl Nitrogen - dissolved	mg-N/L		< 0.10	J g 0.21	0.19	0.26	0.16	< 0.10	< 0.10
8	Phosphorus - total	mg-P/L		< 0.03	< 0.03	0.06	< 0.03	0.10	< 0.03	< 0.03
8	Total Suspended Solids	mg/L		< 1	14	29	7	6	7	14
8	Nitrate + Nitrite	mg-N/L		0.12	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
8	Total Nitrogen (calculated)	mg-N/L		0.49	0.40	0.23	0.31	J g 0.20	< 0.10	< 0.10

Table B-20 (Continued). 4-Inch Filter Column Effluent Data

Unit	Parameter	Units	RUN 17A	RUN 18	RUN 19	RUN 20	RUN 21	RUN 22	RUN 23	RUN 24
9	Filter Media	(desc.)	Superior 30	Superior 30	Superior 30	Superior 30	Superior 30	Superior 30	Superior 30	Superior 30
9	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
9	Flow Started	(date)	Column not run	11-Dec-04	19-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
9	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
9	Pilot Log #	(#)		18-9E	19-9E	20-9E	21-9E	22-9E	23-9E	24-9E
9	Lab ID #	(#)		0412301-01	0412453-01	0503366-01	0503557-01	0504445-01	0505160-01	0505404-01
9	pH (field)	S.U.		7.1	7.1	7.2	7.2	7.4	7.5	7.7
9	EC (field)	µS		2,060	1,863	3,004	633	3,648	620	420
9	Turbidity (field)	NTU		21.5	156	113	41	35	58	186
9	Temperature (field)	°C		13.9	13.7	9.2	10.4	12.6	12.5	12.5
9	Acid Soluble Aluminum	µg/L		89	452	371	272	56	164	80
9	Aluminum - total	µg/L		293	1,933	2,432	836	594	1,120	4,147
9	Iron - total	µg/L		541	1,970	3,490	1,120	860	1,910	4,960
9	Aluminum - dissolved	µg/L		< 25	< 25	< 25	< 25	< 25	< 25	< 25
9	Iron - dissolved	µg/L		32	< 25	< 25	60	72	115	< 25
9	Alkalinity - total	mg-$CaCO_3$/L		28	26	38	35	30	68	18
9	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.15	0.22	0.28
9	Kjeldahl Nitrogen - total	mg-N/L		0.18	0.43	0.49	0.66	J g 0.35	0.24	0.32
9	Kjeldahl Nitrogen - dissolved	mg-N/L		0.11	J g 0.13	0.30	0.31	0.27	0.20	0.12
9	Phosphorus - total	mg-P/L		< 0.03	0.15	0.06	0.04	0.16	0.25	0.42
9	Total Suspended Solids	mg/L		10	20	32	13	9	12	41
9	Nitrate + Nitrite	mg-N/L		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
9	Total Nitrogen (calculated)	mg-N/L		0.18	0.43	0.49	0.66	J g 0.35	0.24	0.32
10	Filter Media	(desc.)	Superior 30	Superior 30	Superior 30	Superior 30	Superior 30	Superior 30	Superior 30	Superior 30
10	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
10	Flow Started	(date)	Column not run	11-Dec-04	19-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
10	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
10	Pilot Log #	(#)		18-10E	19-10E	20-10E	21-10E	22-10E	23-10E	24-10E
10	Lab ID #	(#)		0412364-1	0412442-01	0503345-01	0503556-01	0504458-01	0505161-01	0505398-01
10	pH (field)	S.U.		7.1	7.1	7.3	7.3	7.5	7.5	7.8
10	EC (field)	µS		2,042	1,861	3,002	632	3,648	623	417
10	Turbidity (field)	NTU		22.1	157	118	35.8	34.3	64.4	200
10	Temperature (field)	°C		13.0	13.8	9.3	10.5	12.6	12.5	12.5
10	Acid Soluble Aluminum	µg/L		55	348	396	359	35	166	92
10	Aluminum - total	µg/L		466	1,474	2,063	886	621	1,291	3,690
10	Iron - total	µg/L		591	3,080	3,010	1,170	798	1,940	4,560
10	Aluminum - dissolved	µg/L		< 25	< 25	< 25	< 25	< 25	< 25	< 25
10	Iron - dissolved	µg/L		33	< 25	< 25	67	< 25	120	< 25
10	Alkalinity - total	mg-$CaCO_3$/L		28	39	38	34	30	57	18
10	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	0.04	0.08	0.22	0.28
10	Kjeldahl Nitrogen - total	mg-N/L		0.36	0.51	0.35	0.74	J g 0.71	0.87	0.28
10	Kjeldahl Nitrogen - dissolved	mg-N/L		0.34	J g 0.21	0.19	0.56	0.59	0.82	0.18
10	Phosphorus - total	mg-P/L		< 0.03	0.05	0.11	< 0.03	0.17	0.26	0.41
10	Total Suspended Solids	mg/L		J a 12	36	26	13	7	14	40
10	Nitrate + Nitrite	mg-N/L		0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
10	Total Nitrogen (calculated)	mg-N/L		0.46	0.51	0.35	0.74	J g 0.71	0.87	0.28

Table B-20 (Continued). 4-Inch Filter Column Effluent Data

Unit	Parameter	Units	RUN 17A	RUN 18	RUN 19	RUN 20	RUN 21	RUN 22	RUN 23	RUN 24
11	Filter Media	(desc.)	Limestone	Limestone	Limestone	Limestone	Limestone	Limestone	Limestone	Limestone
11	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
11	Flow Started	(date)	Column not run	11-Dec-04	19-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
11	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
11	Pilot Log #	(#)		18-11E	19-11E	20-11E	21-11E	22-11E	23-11E	24-11E
11	Lab ID #	(#)		0412365-1	0412441-01	0503350-01	0503537-01	0504444-01	0505162-01	0505406-01
11	pH (field)	S.U.		7.7	7.7	8.3	8.1	8.3	8.1	8.9
11	EC (field)	µS		2,086	1,881	3,037	672	3,656	651	445
11	Turbidity (field)	NTU		27.4	175	94.9	32.2	40.5	47.5	144
11	Temperature (field)	°C		13.3	13.8	9.4	10.5	12.6	12.6	12.2
11	Acid Soluble Aluminum	µg/L		85	458	363	401	27	135	131
11	Aluminum - total	µg/L		574	1,676	1,880	813	749	911	3,161
11	Iron - total	µg/L		705	3,590	2,590	964	1,150	1,440	3,760
11	Aluminum - dissolved	µg/L		28	32	< 25	< 25	31	30	49
11	Iron - dissolved	µg/L		33	25	< 25	38	< 25	107	< 25
11	Alkalinity - total	mg-$CaCO_3$/L		48	52	54	62	40	78	34
11	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.18	0.24	0.31
11	Kjeldahl Nitrogen - total	mg-N/L		0.49	0.60	0.37	0.49	J g 0.30	0.36	0.24
11	Kjeldahl Nitrogen - dissolved	mg-N/L		0.35	J g 0.23	0.19	0.42	0.20	0.26	0.20
11	Phosphorus - total	mg-P/L		< 0.03	0.05	0.11	0.03	0.42	0.24	0.39
11	Total Suspended Solids	mg/L		J a 13	26	28	8	10	8	25
11	Nitrate + Nitrite	mg-N/L		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
11	Total Nitrogen (calculated)	mg-N/L		0.49	0.60	0.37	0.49	J g 0.30	0.36	0.24
12	Filter Media	(desc.)	Limestone	Limestone	Limestone	Limestone	Limestone	Limestone	Limestone	Limestone
12	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
12	Flow Started	(date)	Column not run	11-Dec-04	19-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
12	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
12	Pilot Log #	(#)		18-12E	19-12E	20-12E	21-12E	22-12E	23-12E	24-12E
12	Lab ID #	(#)		0412366-01	0412451-01	0503365-01	0503538-01	0504467-01	0505140-01	0505399-01
12	pH (field)	S.U.		7.7	7.7	8.2	8.0	8.3	8.1	8.4
12	EC (field)	µS		2,098	1,884	3,035	673	3,664	651	444
12	Turbidity (field)	NTU		26.4	184	105	33	50	50	144
12	Temperature (field)	°C		13.2	13.8	9.3	10.6	12.6	12.6	12.4
12	Acid Soluble Aluminum	µg/L		72	471	394	344	46	107	80
12	Aluminum - total	µg/L		551	2,025	2,303	802	839	1,031	3,264
12	Iron - total	µg/L		687	3,160	3,110	990	1,110	1,560	3,830
12	Aluminum - dissolved	µg/L		51	< 25	26	< 25	26	28	68
12	Iron - dissolved	µg/L		47	< 25	< 25	40	40	106	64
12	Alkalinity - total	mg-$CaCO_3$/L		44	46	56	62	44	74	30
12	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.18	0.15	0.31
12	Kjeldahl Nitrogen - total	mg-N/L		0.50	0.52	0.33	0.44	J g < 0.10	0.90	0.43
12	Kjeldahl Nitrogen - dissolved	mg-N/L		0.47	J g 0.22	0.30	0.40	< 0.10	0.50	0.19
12	Phosphorus - total	mg-P/L		< 0.03	0.06	0.05	< 0.03	0.18	0.26	0.39
12	Total Suspended Solids	mg/L		J a 12	16	32	8	11	13	27
12	Nitrate + Nitrite	mg-N/L		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
12	Total Nitrogen (calculated)	mg-N/L		0.50	0.52	0.33	0.44	J g < 0.10	0.90	0.43

Table B-20 (Continued). 4-Inch Filter Column Effluent Data

Unit	Parameter	Units	RUN 17A	RUN 18	RUN 19	RUN 20	RUN 21	RUN 22	RUN 23	RUN 24
13	Filter Media	(desc.)	Fe-Mod AA	Fe-Mod AA	Fe-Mod AA	Fe-Mod AA	Fe-Mod AA	Fe-Mod AA	Fe-Mod AA	Fe-Mod AA
13	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
13	Flow Started	(date)	Column not run	11-Dec-04	19-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
13	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
13	Pilot Log #	(#)		18-13E	19-13E	20-13E	21-13E	22-13E	23-13E	24-13E
13	Lab ID #	(#)		0412252-01	0412454-01	0503404-01	0503555-01	0504443-01	0505141-01	0505402-01
13	pH (field)	S.U.		6.5	6.3	6.5	6.6	7.5	7.0	6.9
13	EC (field)	µS		2,090	1,932	3,042	662	3,672	644	433
13	Turbidity (field)	NTU		0.2	0.3	0.2	1.8	0.5	40.2	93.6
13	Temperature (field)	°C		13.3	13.8	9.0	10.5	12.6	12.6	12.3
13	Acid Soluble Aluminum	µg/L		< 25	< 25	< 25	27	< 25	< 25	< 25
13	Aluminum - total	µg/L		< 25	< 25	< 25	36	< 25	699	2,159
13	Iron - total	µg/L		< 25	< 25	< 25	28	< 25	1,210	2,440
13	Aluminum - dissolved	µg/L		< 25	< 25	< 25	< 25	< 25	< 25	< 25
13	Iron - dissolved	µg/L		< 25	< 25	< 25	< 25	< 25	< 25	< 25
13	Alkalinity - total	mg-CaCO$_3$/L		2	6	2	6	24	25	10
13	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.06	< 0.03	< 0.03
13	Kjeldahl Nitrogen - total	mg-N/L		< 0.10	0.38	0.19	0.43	J g 0.12	0.63	0.79
13	Kjeldahl Nitrogen - dissolved	mg-N/L		< 0.10	J g 0.35	0.18	< 0.10	< 0.10	0.19	< 0.10
13	Phosphorus - total	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.11	< 0.03	< 0.03
13	Total Suspended Solids	mg/L		< 1	< 1	5	< 1	3	14	31
13	Nitrate + Nitrite	mg-N/L		0.15	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
13	Total Nitrogen (calculated)	mg-N/L		0.15	0.38	0.19	0.43	J g 0.12	0.63	0.79
14	Filter Media	(desc.)	Fe-Mod AA	Fe-Mod AA	Fe-Mod AA	Fe-Mod AA	Fe-Mod AA	Fe-Mod AA	Fe-Mod AA	Fe-Mod AA
14	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
14	Flow Started	(date)	Column not run	11-Dec-04	19-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
14	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
14	Pilot Log #	(#)		18-14E	19-14E	20-14E	21-14E	22-14E	23-14E	24-14E
14	Lab ID #	(#)		0412253-01	0412452-01	0503358-01	0503548-01	0504468-01	0505142-01	0505413-01
14	pH (field)	S.U.		6.5	6.3	6.5	6.7	7.5	6.9	7.0
14	EC (field)	µS		2,098	1,899	3,041	529	3,524	649	438
14	Turbidity (field)	NTU		0.1	2.0	0.7	0.5	0.5	41.0	76.4
14	Temperature (field)	°C		13.4	13.9	9.2	10.6	12.6	12.7	12.3
14	Acid Soluble Aluminum	µg/L		< 25	< 25	< 25	< 25	< 25	< 25	< 25
14	Aluminum - total	µg/L		< 25	< 25	< 25	< 25	< 25	767	1,655
14	Iron - total	µg/L		< 25	< 25	< 25	< 25	< 25	1,180	1,930
14	Aluminum - dissolved	µg/L		< 25	< 25	< 25	< 25	< 25	< 25	< 25
14	Iron - dissolved	µg/L		< 25	< 25	< 25	< 25	< 25	< 25	< 25
14	Alkalinity - total	mg-CaCO$_3$/L		2	< 1	2	5	20	36	18
14	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.09	< 0.03	< 0.03
14	Kjeldahl Nitrogen - total	mg-N/L		< 0.10	0.23	< 0.10	< 0.10	J g < 0.10	0.17	0.25
14	Kjeldahl Nitrogen - dissolved	mg-N/L		< 0.10	J g 0.19	< 0.10	< 0.10	< 0.10	0.11	< 0.10
14	Phosphorus - total	mg-P/L		< 0.03	< 0.03	0.03	< 0.03	0.17	< 0.03	< 0.03
14	Total Suspended Solids	mg/L		3	2	2	4	4	14	28
14	Nitrate + Nitrite	mg-N/L		0.14	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
14	Total Nitrogen (calculated)	mg-N/L		0.14	0.23	< 0.10	< 0.10	J g < 0.10	0.17	0.25

Table B-20 (Continued). 4-Inch Filter Column Effluent Data

Unit	Parameter	Units	RUN 17A	RUN 18	RUN 19	RUN 20	RUN 21	RUN 22	RUN 23	RUN 24
15	Filter Media	(desc.)	GFH	GFH	GFH	GFH	GFH	GFH	GFH	GFH
15	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
15	Flow Started	(date)	Column not run	11-Dec-04	19-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
15	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
15	Pilot Log #	(#)		18-15E	19-15E	20-15E	21-15E	22-15E	23-15E	24-15E
15	Lab ID #	(#)		0412254-01	0412450-01	0503357-01	0503553-01	0504469-01	0505138-01	0505418-01
15	pH (field)	S.U.		5.8	5.9	5.9	5.1	6.3	5.0	5.2
15	EC (field)	µS		2,058	1,884	3,033	668	3,654	659	523
15	Turbidity (field)	NTU		0.5	1.0	3.5	3.8	4.2	30.2	1.6
15	Temperature (field)	°C		13.6	13.8	9.4	10.7	12.6	12.7	12.6
15	Acid Soluble Aluminum	µg/L		< 25	32	65	59	56	< 25	29
15	Aluminum - total	µg/L		< 25	32	59	61	82	669	48
15	Iron - total	µg/L		< 25	26	59	67	81	998	< 25
15	Aluminum - dissolved	µg/L		< 25	< 25	< 25	< 25	< 25	< 25	43
15	Iron - dissolved	µg/L		< 25	< 25	< 25	25	< 25	31	< 25
15	Alkalinity - total	mg-$CaCO_3$/L		2	< 1	2	< 1	1	1	< 1
15	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.10	< 0.03	< 0.03
15	Kjeldahl Nitrogen - total	mg-N/L		< 0.10	0.28	< 0.10	0.28	J g < 0.10	0.57	1.22
15	Kjeldahl Nitrogen - dissolved	mg-N/L		< 0.10	J g 0.15	< 0.10	< 0.10	< 0.10	0.22	0.24
15	Phosphorus - total	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.15	< 0.03	< 0.03
15	Total Suspended Solids	mg/L		16	< 1	3	< 1	5	11	< 1
15	Nitrate + Nitrite	mg-N/L		0.66	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
15	Total Nitrogen (calculated)	mg-N/L		0.66	0.28	< 0.10	0.28	J g < 0.10	0.57	1.22
16	Filter Media	(desc.)	GFH	GFH	GFH	GFH	GFH	GFH	GFH	GFH
16	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
16	Flow Started	(date)	Column not run	11-Dec-04	19-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
16	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
16	Pilot Log #	(#)		18-16E	19-16E	20-16E	21-16E	22-16E	23-16E	24-16E
16	Lab ID #	(#)		0412255-01	0412428-01	0503402-01	0503558-01	0504448-01	0505149-01	0505394-01
16	pH (field)	S.U.		5.9	5.9	5.6	4.7	6.2	6.0	5.1
16	EC (field)	µS		2,059	1,882	3,039	672	3,646	646	505
16	Turbidity (field)	NTU		0.9	1.2	7.7	5.7	2.9	46.2	3.3
16	Temperature (field)	°C		13.3	13.6	9.3	10.6	12.6	12.8	12.5
16	Acid Soluble Aluminum	µg/L		< 25	31	R c 221	104	73	28	< 25
16	Aluminum - total	µg/L		< 25	35	R c 89	110	67	919	58
16	Iron - total	µg/L		< 25	< 25	119	115	124	1300	37
16	Aluminum - dissolved	µg/L		< 25	< 25	< 25	< 25	< 25	< 25	43
16	Iron - dissolved	µg/L		< 25	< 25	< 25	< 25	60	46	< 25
16	Alkalinity - total	mg-$CaCO_3$/L		2	< 1	4	< 1	1	5	< 1
16	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.10	< 0.03	< 0.03
16	Kjeldahl Nitrogen - total	mg-N/L		< 0.10	0.29	< 0.10	0.19	J g < 0.1	0.89	0.44
16	Kjeldahl Nitrogen - dissolved	mg-N/L		< 0.10	J g 0.17	< 0.10	< 0.10	< 0.1	0.52	< 0.10
16	Phosphorus - total	mg-P/L		< 0.03	< 0.03	0.03	< 0.03	0.38	< 0.03	< 0.03
16	Total Suspended Solids	mg/L		2	< 1	6	2	3	11	1
16	Nitrate + Nitrite	mg-N/L		0.73	< 0.10	< 0.10	< 0.10	< 0.1	< 0.10	< 0.10
16	Total Nitrogen (calculated)	mg-N/L		0.73	0.29	< 0.10	0.19	J g < 0.1	0.89	0.44

Table B-20 (Continued). 4-Inch Filter Column Effluent Data

Unit	Parameter	Units	RUN 17A	RUN 18	RUN 19	RUN 20	RUN 21	RUN 22	RUN 23	RUN 24
17	Filter Media	(desc.)	Bayoxide E33	Bayoxide E33	Bayoxide E33	Bayoxide E33	Bayoxide E33	Bayoxide E33	Bayoxide E33	Bayoxide E33
17	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
17	Flow Started	(date)	Column not run	11-Dec-04	19-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
17	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
17	Pilot Log #	(#)		18-17E	19-17E	20-17E	21-17E	22-17E	23-17E	24-17E
17	Lab ID #	(#)		0412367-1	0412438-01	0503347-01	0503552-01	0504460-01	0505136-01	0505409-01
17	pH (field)	S.U.		7.7	7.5	7.6	7.6	7.6	7.7	7.3
17	EC (field)	µS		2,086	1,882	3,010	632	3,642	620	477
17	Turbidity (field)	NTU		4.1	108	108	26.1	19.1	34.0	1.9
17	Temperature (field)	°C		14.0	13.7	9.2	10.6	12.6	12.6	12.5
17	Acid Soluble Aluminum	µg/L		69	278	363	210	267	39	< 25
17	Aluminum - total	µg/L		76	1,455	2,019	576	298	673	30
17	Iron - total	µg/L		83	2,320	3,110	809	360	955	< 25
17	Aluminum - dissolved	µg/L		< 25	39	< 25	< 25	< 25	< 25	< 25
17	Iron - dissolved	µg/L		< 25	37	< 25	< 25	< 25	< 25	< 25
17	Alkalinity - total	mg-$CaCO_3$/L		48	46	44	38	42	58	54
17	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	0.07	0.08	< 0.03	< 0.03
17	Kjeldahl Nitrogen - total	mg-N/L		0.52	0.42	0.45	0.54	J g < 0.10	0.42	0.43
17	Kjeldahl Nitrogen - dissolved	mg-N/L		0.20	J g 0.13	0.10	0.36	< 0.10	0.21	< 0.10
17	Phosphorus - total	mg-P/L		< 0.03	0.03	0.14	0.03	0.10	< 0.03	< 0.03
17	Total Suspended Solids	mg/L		J a 4	20	38	7	9	< 1	< 1
17	Nitrate + Nitrite	mg-N/L		0.12	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
17	Total Nitrogen (calculated)	mg-N/L		0.64	0.42	0.45	0.54	J g < 0.10	0.42	0.43
18	Filter Media	(desc.)	Bayoxide E33	Bayoxide E33	Bayoxide E33	Bayoxide E33	Bayoxide E33	Bayoxide E33	Bayoxide E33	Bayoxide E33
18	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
18	Flow Started	(date)	Column not run	11-Dec-04	19-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
18	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
18	Pilot Log #	(#)		18-18E	19-18E	20-18E	21-18E	22-18E	23-18E	24-18E
18	Lab ID #	(#)		0412298-01	0412437-01	0503403-01	0503544-01	0504459-01	0505137-01	0505408-01
18	pH (field)	S.U.		7.7	7.5	7.6	7.7	7.7	7.6	7.5
18	EC (field)	µS		2,085	1,885	3,010	627	3,658	616	444
18	Turbidity (field)	NTU		1.5	96.3	121	22.5	11.8	36.1	127
18	Temperature (field)	°C		13.5	13.8	9.3	10.6	12.6	12.6	12.5
18	Acid Soluble Aluminum	µg/L		< 25	312	88	200	< 25	35	39
18	Aluminum - total	µg/L		34	1,354	1,684	462	231	830	2,745
18	Iron - total	µg/L		40	2,010	2,540	654	308	1,140	3,290
18	Aluminum - dissolved	µg/L		< 25	< 25	< 25	< 25	< 25	< 25	< 25
18	Iron - dissolved	µg/L		< 25	< 25	< 25	< 25	< 25	< 25	< 25
18	Alkalinity - total	mg-$CaCO_3$/L		50	46	40	33	68	50	38
18	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.11	< 0.03	< 0.03
18	Kjeldahl Nitrogen - total	mg-N/L		< 0.10	0.41	0.40	0.19	J g 0.62	0.80	0.38
18	Kjeldahl Nitrogen - dissolved	mg-N/L		< 0.10	J g 0.14	0.35	0.18	0.58	0.20	< 0.10
18	Phosphorus - total	mg-P/L		< 0.03	0.03	0.07	< 0.03	0.19	< 0.03	< 0.03
18	Total Suspended Solids	mg/L		< 1	11	7	9	6	10	35
18	Nitrate + Nitrite	mg-N/L		0.12	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
18	Total Nitrogen (calculated)	mg-N/L		0.12	0.41	0.40	0.19	J g 0.62	0.80	0.38

Table B-20 (Continued). 4-Inch Filter Column Effluent Data

Unit	Parameter	Units	RUN 17A	RUN 18	RUN 19	RUN 20	RUN 21	RUN 22	RUN 23	RUN 24
Clarifier	Filter Media	(desc.)	Pumped Eff	Pumped Eff	Pumped Eff	Pumped Eff	Pumped Eff	Pumped Eff	Pumped Eff	Pumped Eff
(Initial)	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
	Flow Started	(date)	Column not run	11-Dec-04	19-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
CI	Date Sampled	(date)		13-Dec-04	21-Dec-04	12-Mar-05	23-Mar-05	23-Apr-05	1-May-05	15-May-05
CI	Pilot Log #	(#)		18-CI	19-CLAR	20-CI		22-CL	23-CL	24-CL
CI	Lab ID #	(#)		0412368-1	0412434-01	0503283-01		0504414-01	0505053-1	0505336-01
CI	pH (field)	S.U.		7.1	7.3	7.6	7.4	7.2	7.5	8.1
CI	EC (field)	µS		2,055	1,863	3,040	630	3,624	622	445
CI	Turbidity (field)	NTU		89.7	584	427	147	245	196	337
CI	Temperature (field)	°C		13.6	14.0	10.5	5.0	9.7	11.8	13.5
CI	Acid Soluble Aluminum	µg/L		194	1,170	209		135	135	144
CI	Aluminum - total	µg/L		1,820	5,285	7,398		4,247	3,054	4,556
CI	Iron - total	µg/L		2,350	10,100	12,300		6,370	4,500	6,480
CI	Aluminum - dissolved	µg/L		< 25	< 25	< 25		< 25	28	< 25
CI	Iron - dissolved	µg/L		61	< 25	26		52	152	< 25
CI	Alkalinity - total	mg-$CaCO_3$/L		24	26	38		30	56	18
CI	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	0.05		0.07	0.20	0.32
CI	Kjeldahl Nitrogen - total	mg-N/L		1.00	1.79	0.81		J g 0.65	1.04	0.60
CI	Kjeldahl Nitrogen - dissolved	mg-N/L		0.70	J g 0.29	0.36		0.30	0.39	0.14
CI	Phosphorus - total	mg-P/L		0.16	0.20	0.38		0.25	0.34	0.55
CI	Total Suspended Solids	mg/L		J a 58	258	172		116	121	177
CI	Nitrate + Nitrite	mg-N/L		0.14	< 0.10	< 0.10		< 0.10	< 0.10	< 0.10
CI	Total Nitrogen (calculated)	mg-N/L		1.14	1.79	0.81		J g 0.65	1.04	0.60
Clarifier	Filter Media	(desc.)	Pumped Eff Dup	Pumped Eff Dup	Pumped Eff Dup	Pumped Eff Dup	Pumped Eff Dup	Pumped Eff Dup	Pumped Eff Dup	Pumped Eff Dup
(Initial)	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
	Flow Started	(date)	Column not run	11-Dec-04	19-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
Duplicate	Date Sampled	(date)		13-Dec-04	Not collected	15-Mar-05	Not collected	23-Apr-05	1-May-05	15-May-05
	Pilot Log #	(#)		18-CID		20-CID		22-CLD	23-CLD	24-CID
CID	Lab ID #	(#)		0412369-1		0503281-01		0504413-01	0505054-1	0505335-01
CID	pH (field)	S.U.		7.1		7.6		7.2	7.5	8.1
CID	EC (field)	µS		2,060		3,040		3,624	625	439
CID	Turbidity (field)	NTU		90.1		427		265	194	330
CID	Temperature (field)	°C		13.8		10.5		9.7	12.2	13.5
CID	Acid Soluble Aluminum	µg/L		202		209		117	153	149
CID	Aluminum - total	µg/L		1,660		7,322		4,065	3,967	4,620
CID	Iron - total	µg/L		2,270		14,000		6,220	5,330	6,640
CID	Aluminum - dissolved	µg/L		< 25		< 25		< 25	29	< 25
CID	Iron - dissolved	µg/L		67		28		51	154	< 25
CID	Alkalinity - total	mg-$CaCO_3$/L		24		38		30	58	18
CID	Phosphorus - dissolved	mg-P/L		< 0.03		0.04		0.07	0.20	0.32
CID	Kjeldahl Nitrogen - total	mg-N/L		1.15		0.84		J g 0.61	0.82	0.66
CID	Kjeldahl Nitrogen - dissolved	mg-N/L		0.51		0.15		0.50	0.48	< 0.10
CID	Phosphorus - total	mg-P/L		0.16		0.40		0.31	0.27	0.56
CID	Total Suspended Solids	mg/L		J a 60		156		109	131	166
CID	Nitrate + Nitrite	mg-N/L		0.14		< 0.10		< 0.10	< 0.10	< 0.10
CID	Total Nitrogen (calculated)	mg-N/L		1.29		0.84		J g 0.61	0.82	0.66

Table B-20 (Continued). 4-Inch Filter Column Effluent Data

Unit	Parameter	Units	RUN 17A	RUN 18	RUN 19	RUN 20	RUN 21	RUN 22	RUN 23	RUN 24
Clarifier	Filter Media	(desc.)	Pumped Eff	Pumped Eff	Pumped Eff	Pumped Eff	Pumped Eff	Pumped Eff	Pumped Eff	Pumped Eff
(Final)	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
	Flow Started	(date)	Column not run	11-Dec-04	19-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
CF	Date Sampled	(date)		18-Dec-04	23-Dec-04	18-Mar-05	26-Mar-05	30-Apr-05	7-May-05	21-May-05
CF	Pilot Log #	(#)		18-CF	19-CF	20-CF	21-CF	22-CF	23-CF	24-CF
CF	Lab ID #	(#)		0412432-01	0412511-01	0503479-01	0503572-01	0505058-01	0505201-01	0505445-01
CF	pH (field)	S.U.		7.1	7.6	7.7	7.6	7.6	7.9	8.2
CF	EC (field)	µS		2,061	1,926	3,002	637	3,655	624	425
CF	Turbidity (field)	NTU		125	595	827	156	280	202	326
CF	Temperature (field)	°C		12.8	7.4	10.0	8.3	12.4	11.2	14.0
CF	Acid Soluble Aluminum	µg/L		195	813	268	709	< 25	159	66
CF	Aluminum - total	µg/L		999	7,354	13,720	2,874	5,276	3,922	6,856
CF	Iron - total	µg/L		1,720	11,600	19,100	3,440	7,810	5,790	8,970
CF	Aluminum - dissolved	µg/L		< 25	< 25	213	< 25	< 25	< 25	< 25
CF	Iron - dissolved	µg/L		45	81	249	73	< 25	162	50
CF	Alkalinity - total	mg-$CaCO_3$/L		39	24	38	36	32	59	18
CF	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.20	0.35	0.35
CF	Kjeldahl Nitrogen - total	mg-N/L		1.17	1.12	1.44	1.46	J g 1.13	0.82	< 0.10
CF	Kjeldahl Nitrogen - dissolved	mg-N/L		0.31	J g 0.43	0.30	0.11	0.32	0.37	< 0.10
CF	Phosphorus - total	mg-P/L		0.05	0.19	0.76	0.29	0.36	0.36	0.57
CF	Total Suspended Solids	mg/L		10	264	427	96	153	126	149
CF	Nitrate + Nitrite	mg-N/L		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
CF	Total Nitrogen (calculated)	mg-N/L		1.17	1.12	1.44	1.46	J g 1.13	0.82	< 0.10
Clarifier	Filter Media	(desc.)	Pumped Eff Dup	Pumped Eff Dup	Pumped Eff Dup	Pumped Eff Dup	Pumped Eff Dup	Pumped Eff Dup	Pumped Eff Dup	Pumped Eff Dup
(Final)	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
	Flow Started	(date)	Column not run	11-Dec-04	19-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
Duplicate	Date Sampled	(date)		18-Dec-04	23-Dec-04	18-Mar-05	26-Mar-05	30-Apr-05	7-May-05	21-May-05
	Pilot Log #	(#)		18-CFD	19-CFD	20-CFD	21-CFD	22-CFD	23-CFD	24-CFD
CFD	Lab ID #	(#)		0412433-01	0412510-01	0503478-01	0503573-01	0505059-01	0505202-01	0505446-01
CFD	pH (field)	S.U.		7.1	7.6	7.7	7.7	7.6	7.9	8.2
CFD	EC (field)	µS		2,060	1,926	3,002	640	3,656	621	425
CFD	Turbidity (field)	NTU		120	601	827	155	274	201	326
CFD	Temperature (field)	°C		12.8	7.4	10.0	8.3	12.7	11.3	14.0
CFD	Acid Soluble Aluminum	µg/L		210	1,200	186	628	< 25	167	139
CFD	Aluminum - total	µg/L		959	9,384	13,390	2,848	5,522	3,176	7,031
CFD	Iron - total	µg/L		1,640	19,200	17,700	3,240	7,630	5,040	8,260
CFD	Aluminum - dissolved	µg/L		< 25	< 25	894	< 25	< 25	< 25	< 25
CFD	Iron - dissolved	µg/L		46	< 25	1,250	82	< 25	159	28
CFD	Alkalinity - total	mg-$CaCO_3$/L		26	22	40	35	28	58	18
CFD	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.20	0.35	0.30
CFD	Kjeldahl Nitrogen - total	mg-N/L		1.12	2.10	1.52	1.35	J g 0.55	0.85	< 0.10
CFD	Kjeldahl Nitrogen - dissolved	mg-N/L		0.36	J g 1.28	0.26	< 0.10	< 0.10	0.27	< 0.10
CFD	Phosphorus - total	mg-P/L		< 0.03	0.37	0.76	0.31	0.34	0.37	0.53
CFD	Total Suspended Solids	mg/L		49	306	364	73	159	133	155
CFD	Nitrate + Nitrite	mg-N/L		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
CFD	Total Nitrogen (calculated)	mg-N/L		1.12	2.10	1.52	1.35	J g 0.55	0.85	< 0.10

Table B-20 (Continued). 4-Inch Filter Column Effluent Data

Unit	Parameter	Units	RUN 17A	RUN 18	RUN 19	RUN 20	RUN 21	RUN 22	RUN 23	RUN 24
21	Filter Media	(desc.)		Alhambra H2O	Alhambra H2O	Alhambra H2O	Alhambra H2O	Alhambra H2O	Alhambra H2O	Alhambra H2O
	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
Eq Blk	Flow Started	(date)		11-Dec-04	19-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
	Date Sampled	(date)	Not Collected	13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
21	Pilot Log #	(#)		18-21E	19-21E	20-21E	21-21E	22-21E	23-21E	24-21E
21	Lab ID #	(#)		0412290-1	0412445-01	0503401-01	0503547-01	0504447-01	0505147-01	0505419-01
21	pH (field)	S.U.		5.9	7.0	5.9	6.4	6.1	6.0	5.9
21	EC (field)	µS		< 1	< 1	< 1	< 1	< 1	< 1	< 1
21	Turbidity (field)	NTU		< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
21	Temperature (field)	°C		14.0	13.4	9.4	11.0	12.9	12.2	12.5
21	Acid Soluble Aluminum	µg/L		< 25	< 25	< 25	< 25	< 25	< 25	< 25
21	Aluminum - total	µg/L		< 25	< 25	< 25	< 25	< 25	< 25	< 25
21	Aluminum - dissolved	µg/L		< 25	< 25	< 25	< 25	< 25	< 25	< 25
21	Alkalinity - total	mg-$CaCO_3$/L		< 1	< 1	< 1	< 1	< 1	< 1	< 1
21	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
21	Kjeldahl Nitrogen - total	mg-N/L		< 0.10	< 0.10	< 0.10	< 0.10	J g < 0.10	< 0.10	< 0.10
21	Kjeldahl Nitrogen - dissolved	mg-N/L		< 0.10	J g < 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
21	Phosphorus - total	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
21	Total Suspended Solids	mg/L		< 1	< 1	< 1	< 1	2	< 1	< 1
21	Nitrate + Nitrite	mg-N/L		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
21	Total Nitrogen (calculated)	mg-N/L		< 0.10	< 0.10	< 0.10	< 0.10	J g < 0.10	< 0.10	< 0.10
22	Filter Media	(desc.)		Alhambra H2O	Alhambra H2O	Alhambra H2O	Alhambra H2O	Alhambra H2O	Alhambra H2O	Alhambra H2O
	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
Btl Blk	Flow Started	(date)		11-Dec-04	19-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
	Date Sampled	(date)	Not Collected	13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
22	Pilot Log #	(#)		18-22E	19-AL-BB	20-22E	21-22E	22-22E	23-22E	24-22E
22	Lab ID #	(#)		0412293-01	0412427-01	0503341-01	0503551-01	0504453-01	0505148-01	0505416-01
22	pH (field)	S.U.		5.9	7.0	5.9	6.4	6.1	6.0	5.9
22	EC (field)	µS		< 1	< 1	< 1	< 1	< 1	< 1	< 1
22	Turbidity (field)	NTU		< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
22	Temperature (field)	°C		14.0	13.4	9.4	11.0	12.9	12.2	12.5
22	Acid Soluble Aluminum	µg/L		< 25	< 25	< 25	< 25	< 25	< 25	< 25
22	Aluminum - total	µg/L		< 25	< 25	< 25	< 25	< 25	< 25	< 25
22	Aluminum - dissolved	µg/L		< 25	< 25	< 25	< 25	< 25	< 25	< 25
22	Alkalinity - total	mg-$CaCO_3$/L		< 1	< 1	2	< 1	< 1	< 1	< 1
22	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
22	Kjeldahl Nitrogen - total	mg-N/L		< 0.10	< 0.10	< 0.10	0.17	J g < 0.10	< 0.10	< 0.10
22	Kjeldahl Nitrogen - dissolved	mg-N/L		< 0.10	J g < 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
22	Phosphorus - total	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
22	Total Suspended Solids	mg/L		1	< 1	< 1	< 1	< 1	< 1	< 1
22	Nitrate + Nitrite	mg-N/L		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
22	Total Nitrogen (calculated)	mg-N/L		< 0.10	< 0.10	< 0.10	0.17	J g < 0.10	< 0.10	< 0.10

Table B-20 (Continued). 4-Inch Filter Column Effluent Data

Unit	Parameter	Units	RUN 17A	RUN 18	RUN 19	RUN 20	RUN 21	RUN 22	RUN 23	RUN 24
23	Filter Media	(desc.)		Dup of 18E	Dup of 1E	Dup of 8E	Dup of 18E	Dup of 1E	Dup of 14E	Dup of 14E
	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
Eff Dup	Flow Started	(date)		11-Dec-04	19-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
	Date Sampled	(date)	Not Collected	13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
23	Pilot Log #	(#)		18-18ED	19-1ED	20-23E	21-23E	22-23E	23-23E	24-23E
23	Lab ID #	(#)		0412295-01	0412436-01	0503364-01	0503543-01	0504450-01	0505143-01	0505403-01
23	pH (field)	S.U.		7.7	7.6	8.0	7.7	8.0	7.2	7.0
23	EC (field)	µS		2,086	1,863	2,835	624	3,649	660	443
23	Turbidity (field)	NTU		1.7	12.5	85	22.1	0.9	38.4	74.2
23	Temperature (field)	°C		13.8	13.9	8.9	10.6	12.6	12.3	12.7
23	Acid Soluble Aluminum	µg/L		< 25	56	272	210	< 25	56	< 25
23	Aluminum - total	µg/L		31	160	1,789	537	30	703	1031
23	Iron - total	µg/L		40	-	-	-	-	-	-
23	Aluminum - dissolved	µg/L		< 25	< 25	43	< 25	< 25	53	50
23	Iron - dissolved	µg/L		< 25	-	-	-	-	-	-
23	Alkalinity - total	mg-$CaCO_3$/L		46	46	28	32	54	22	18
23	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.11	< 0.03	< 0.03
23	Kjeldahl Nitrogen - total	mg-N/L		< 0.10	0.23	0.21	0.16	J g < 0.10	0.17	0.20
23	Kjeldahl Nitrogen - dissolved	mg-N/L		< 0.10	J g < 0.10	< 0.10	0.14	< 0.10	0.16	< 0.10
23	Phosphorus - total	mg-P/L		< 0.03	< 0.03	0.05	0.03	0.14	< 0.03	< 0.03
23	Total Suspended Solids	mg/L		1	3	34	7	3	4	34
23	Nitrate + Nitrite	mg-N/L		0.13	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
23	Total Nitrogen (calculated)	mg-N/L		0.13	0.23	0.21	0.16	J g < 0.10	0.17	0.20
24	Filter Media	(desc.)		Alhambra H2O	Alhambra H2O	Alhambra H2O	Alhambra H2O	Alhambra H2O	Alhambra H2O	Alhambra H2O
	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
Eq Blk	Flow Started	(date)		11-Dec-04	19-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
	Date Sampled	(date)	Not Collected	13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
24	Pilot Log #	(#)		18-24E	19-24E	20-24E	21-24E	22-24E	23-24E	24-24E
24	Lab ID #	(#)		412291-01	0412446-01	0503342-01	0503546-01	0504454-01	0505144-01	0505420-01
24	pH (field)	S.U.		5.9	7.0	5.9	6.4	6.1	6.0	5.9
24	EC (field)	µS		< 1	< 1	< 1	< 1	< 1	< 1	< 1
24	Turbidity (field)	NTU		< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
24	Temperature (field)	°C		14.0	13.4	9.4	11.0	12.9	12.2	12.5
24	Acid Soluble Aluminum	µg/L		< 25	< 25	< 25	< 25	< 25	< 25	< 25
24	Aluminum - total	µg/L		< 25	< 25	< 25	< 25	< 25	< 25	< 25
24	Iron - total	µg/L		< 25	< 25	< 25	< 25	< 25	31	< 25
24	Aluminum - dissolved	µg/L		< 25	< 25	< 25	< 25	< 25	< 25	< 25
24	Iron - dissolved	µg/L		< 25	< 25	< 25	< 25	< 25	< 25	< 25
24	Alkalinity - total	mg-$CaCO_3$/L		< 1	< 1	< 1	< 1	< 1	< 1	< 1
24	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
24	Kjeldahl Nitrogen - total	mg-N/L		< 0.10	< 0.10	0.11	< 0.10	J g < 0.10	< 0.10	< 0.10
24	Kjeldahl Nitrogen - dissolved	mg-N/L		< 0.10	J g < 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
24	Phosphorus - total	mg-P/L		< 0.03	< 0.03	0.06	< 0.03	< 0.03	< 0.03	< 0.03
24	Total Suspended Solids	mg/L		< 1	< 1	< 1	< 1	< 1	< 1	< 1
24	Nitrate + Nitrite	mg-N/L		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
24	Total Nitrogen (calculated)	mg-N/L		< 0.10	< 0.10	< 0.10	< 0.10	J g < 0.10	< 0.10	< 0.10

Table B-20 (Continued). 4-Inch Filter Column Effluent Data

Unit	Parameter	Units	RUN 17A	RUN 18	RUN 19	RUN 20	RUN 21	RUN 22	RUN 23	RUN 24
25	Filter Media	(desc.)		Alhambra H2O	Alhambra H2O	Alhambra H2O	Alhambra H2O	Alhambra H2O	Alhambra H2O	Alhambra H2O
	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
Btl Blk	Flow Started	(date)	Not Collected	11-Dec-04	19-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
25	Pilot Log #	(#)		18-25E	19-FE-BB	20-25E	21-25E	22-25E	23-25E	24-25E
25	Lab ID #	(#)		0412295-1	0412429-01	0503343-01	0503539-01	0504452-01	0505145-01	0505417-01
25	pH (field)	S.U.		5.9	7.0	5.9	6.4	6.1	6.0	5.9
25	EC (field)	µS		< 1	< 1	< 1	< 1	< 1	< 1	< 1
25	Turbidity (field)	NTU		< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
25	Temperature (field)	°C		14.0	13.4	9.4	11.0	12.9	12.2	12.5
25	Acid Soluble Aluminum	µg/L		< 25	< 25	< 25	< 25	< 25	< 25	< 25
25	Aluminum - total	µg/L		< 25	< 25	< 25	< 25	< 25	< 25	< 25
25	Iron - total	µg/L		< 25	< 25	< 25	< 25	< 25	< 25	< 25
25	Aluminum - dissolved	µg/L		< 25	< 25	< 25	< 25	< 25	< 25	< 25
25	Iron - dissolved	µg/L		< 25	< 25	< 25	< 25	< 25	< 25	< 25
25	Alkalinity - total	mg-$CaCO_3$/L		26	< 1	< 1	< 1	< 1	< 1	< 1
25	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
25	Kjeldahl Nitrogen - total	mg-N/L		< 0.10	< 0.10	< 0.10	< 0.10	J g < 0.10	< 0.10	< 0.10
25	Kjeldahl Nitrogen - dissolved	mg-N/L		< 0.10	J g < 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
25	Phosphorus - total	mg-P/L		< 0.03	< 0.03	0.04	0.03	< 0.03	< 0.03	< 0.03
25	Total Suspended Solids	mg/L		< 1	< 1	< 1	< 1	< 1	< 1	< 1
25	Nitrate + Nitrite	mg-N/L		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
25	Total Nitrogen (calculated)	mg-N/L		< 0.10	< 0.10	< 0.10	< 0.10	J g < 0.10	< 0.10	< 0.10
Other	Filter Media	(desc.)			Dup of 16 E	Dup of 14 E				
	Influent Collected	(date)			9-Dec-04	11-Mar-05				
	Flow Started	(date)	Not Collected	Not Collected	19-Dec-04	12-Mar-05				
	Date Sampled	(date)			21-Dec-04	15-Mar-05				
	Pilot Log #	(#)			19-16ED	20-26E				
	Lab ID #	(#)			0412459-01	0503356-01				
	pH (field)	S.U.			5.9	6.5				
	EC (field)	µS			1,883	3,042				
	Turbidity (field)	NTU			1.4	0.7				
	Temperature (field)	°C			13.6	9.2				
	Acid Soluble Aluminum	µg/L			34	< 25				
	Aluminum - total	µg/L			37	< 25				
	Iron - total	µg/L			< 25	< 25				
	Aluminum - dissolved	µg/L			< 25	< 25				
	Iron - dissolved	µg/L			< 25	< 25				
	Alkalinity - total	mg-$CaCO_3$/L			< 1	2				
	Phosphorus - dissolved	mg-P/L			< 0.03	< 0.03				
	Kjeldahl Nitrogen - total	mg-N/L			0.23	< 0.10				
	Kjeldahl Nitrogen - dissolved	mg-N/L			J g 0.16	< 0.10				
	Phosphorus - total	mg-P/L			< 0.03	0.03				
	Total Suspended Solids	mg/L			< 1	< 1				
	Nitrate + Nitrite	mg-N/L			< 0.10	0.11				
	Total Nitrogen (calculated)	mg-N/L			0.23	0.11				

Table B-21. 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
Baker	North	Grab	12/10/2004	18	19:30	7.2	2,147	6.3	210
Baker	North	Grab	12/11/2004	18	19:45	7.2	2,062	6.9	190
1	Eff	Grab	12/11/2004	18	18:00	7.6	3,425	-	0.5
2	Eff	Grab	12/11/2004	18	18:00	7.6	3,139	-	1.0
3	Eff	Grab	12/11/2004	18	18:00	7.1	2,059	-	39.7
4	Eff	Grab	12/11/2004	18	18:00	7.2	2,014	-	41.2
5	Eff	Grab	12/11/2004	18	18:00	7.6	1,747	-	0.1
6	Eff	Grab	12/11/2004	18	18:00	7.9	1,408	-	0.3
7	Eff	Grab	12/11/2004	18	18:00	7.8	1,826	-	0.2
8	Eff	Grab	12/11/2004	18	18:00	7.8	1,856	-	0.2
9	Eff	Grab	12/11/2004	18	18:00	7.3	2,055	-	2.7
10	Eff	Grab	12/11/2004	18	18:00	7.3	2,056	-	3.3
11	Eff	Grab	12/11/2004	18	18:00	7.5	2,074	-	2.7
12	Eff	Grab	12/11/2004	18	18:00	7.5	2,077	-	7.4
13	Eff	Grab	12/11/2004	18	18:00	6.7	2,055	-	0.2
14	Eff	Grab	12/11/2004	18	18:00	6.7	2,098	-	0.2
15	Eff	Grab	12/11/2004	18	18:00	6.1	2,078	-	0.3
16	Eff	Grab	12/11/2004	18	18:00	6.2	2,070	-	0.2
17	Eff	Grab	12/11/2004	18	18:00	7.7	1,903	-	1.1
18	Eff	Grab	12/11/2004	18	18:00	7.9	1,934	-	0.2
Clar	Eff	Grab	12/11/2004	18	15:30	7.1	2,024	13.7	109
1	Eff	Grab	12/12/2004	18	16:00	7.6	2,086	-	0.5
2	Eff	Grab	12/12/2004	18	16:00	7.6	2,043	-	0.6
3	Eff	Grab	12/12/2004	18	16:00	7.0	1,936	-	34.9
4	Eff	Grab	12/12/2004	18	16:00	7.0	1,943	-	33.7
5	Eff	Grab	12/12/2004	18	16:00	7.7	1,974	-	0.4
6	Eff	Grab	12/12/2004	18	16:00	7.7	1,972	-	0.4
7	Eff	Grab	12/12/2004	18	16:00	7.7	1,989	-	1.7
8	Eff	Grab	12/12/2004	18	16:00	7.7	1,970	-	1.0
9	Eff	Grab	12/12/2004	18	16:00	7.1	2,035	-	27.3
10	Eff	Grab	12/12/2004	18	16:00	7.3	2,063	-	28.1
11	Eff	Grab	12/12/2004	18	16:00	7.5	2,043	-	34.0
12	Eff	Grab	12/12/2004	18	16:00	7.4	2,079	-	34.2
13	Eff	Grab	12/12/2004	18	16:00	6.1	2,016	-	0.4
14	Eff	Grab	12/12/2004	18	16:00	6.2	2,089	-	0.3
15	Eff	Grab	12/12/2004	18	16:00	6.8	2,072	-	0.7
16	Eff	Grab	12/12/2004	18	16:00	5.6	2,055	-	0.8
17	Eff	Grab	12/12/2004	18	16:00	7.3	2,034	-	4.8
18	Eff	Grab	12/12/2004	18	16:00	7.5	2,052	-	1.9
Clar	Eff	Grab	12/12/2004	18	16:00	7.2	2,045	-	113
Baker	North	Grab	12/12/2004	18	8:00	7.2	2,010	6.3	188
1	Eff	Comp	12/13/2004	18	8:00	7.8	2,094	-	0.4
2	Eff	Comp	12/13/2004	18	8:00	7.8	2,090	-	0.3
3	Eff	Comp	12/13/2004	18	8:00	7.0	2,055	-	27.3
4	Eff	Comp	12/13/2004	18	8:00	7.1	2,053	-	23.9
5	Eff	Comp	12/13/2004	18	8:00	7.9	1,980	-	0.3
6	Eff	Comp	12/13/2004	18	8:00	8.0	1,978	-	0.2
7	Eff	Comp	12/13/2004	18	8:00	8.1	1,977	-	1.5
8	Eff	Comp	12/13/2004	18	8:00	8.1	1,990	-	1.1
9	Eff	Comp	12/13/2004	18	8:00	7.1	2,060	-	21.5
10	Eff	Comp	12/13/2004	18	8:00	7.1	2,042	-	22.1
11	Eff	Comp	12/13/2004	18	8:00	7.7	2,086	-	27.4
12	Eff	Comp	12/13/2004	18	8:00	7.7	2,098	-	26.4
13	Eff	Comp	12/13/2004	18	8:00	6.5	2,090	-	0.2
14	Eff	Comp	12/13/2004	18	8:00	6.5	2,098	-	0.1
15	Eff	Comp	12/13/2004	18	8:00	5.8	2,058	-	0.5
16	Eff	Comp	12/13/2004	18	8:00	5.9	2,059	-	0.9
17	Eff	Comp	12/13/2004	18	8:00	7.7	2,086	-	4.1
18	Eff	Comp	12/13/2004	18	8:00	7.7	2,085	-	1.5
Clar	Eff	Comp	12/13/2004	18	8:00	7.1	2,055	-	89.7

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
1	Twelve	Grab	12/13/2004	18	13:30	-	-	-	8.5
2	Twelve	Grab	12/13/2004	18	13:30	-	-	-	9.9
3	Twelve	Grab	12/13/2004	18	13:30	-	-	-	30.7
4	Twelve	Grab	12/13/2004	18	13:30	-	-	-	28.1
5	Twelve	Grab	12/13/2004	18	13:30	-	-	-	1.6
6	Twelve	Grab	12/13/2004	18	13:30	-	-	-	1.1
7	Twelve	Grab	12/13/2004	18	13:30	-	-	-	16.9
8	Twelve	Grab	12/13/2004	18	13:30	-	-	-	15.2
9	Twelve	Grab	12/13/2004	18	13:30	-	-	-	27.5
10	Twelve	Grab	12/13/2004	18	13:30	-	-	-	28.3
11	Twelve	Grab	12/13/2004	18	13:30	-	-	-	24.4
12	Twelve	Grab	12/13/2004	18	13:30	-	-	-	29.0
13	Twelve	Grab	12/13/2004	18	13:30	-	-	-	1.5
14	Twelve	Grab	12/13/2004	18	13:30	-	-	-	1.3
15	Twelve	Grab	12/13/2004	18	13:30	-	-	-	6.2
16	Twelve	Grab	12/13/2004	18	13:30	-	-	-	3.6
17	Twelve	Grab	12/13/2004	18	13:30	-	-	-	12.0
18	Twelve	Grab	12/13/2004	18	13:30	-	-	-	8.4
Baker	North	Grab	12/13/2004	18	16:00	7.2	1,989	6.5	189
C1-C4	Interface	C/G	12/13/2004	18	14:45	-	-	-	35.7
C5-C12	Interface	C/G	12/13/2004	18	14:45	-	-	-	34.1
C13-C18	Interface	C/G	12/13/2004	18	14:45	-	-	-	26.5
1	Eff	Grab	12/14/2004	18	14:00	7.6	2,072	14.8	0.2
2	Eff	Grab	12/14/2004	18	14:00	7.7	2,081	14.8	0.2
3	Eff	Grab	12/14/2004	18	14:00	6.9	2,029	14.5	9.9
4	Eff	Grab	12/14/2004	18	14:00	6.9	2,040	14.7	10.2
5	Eff	Grab	12/14/2004	18	14:00	7.7	1,975	14.8	0.1
6	Eff	Grab	12/14/2004	18	14:00	7.6	1,975	14.8	0.1
7	Eff	Grab	12/14/2004	18	14:00	7.9	1,987	14.8	0.9
8	Eff	Grab	12/14/2004	18	14:00	8.0	1,982	14.8	0.6
9	Eff	Grab	12/14/2004	18	14:00	6.9	2,054	14.7	10.2
10	Eff	Grab	12/14/2004	18	14:00	6.9	2,052	14.7	10.5
11	Eff	Grab	12/14/2004	18	14:00	7.9	2,068	14.8	12.3
12	Eff	Grab	12/14/2004	18	14:00	7.7	2,079	14.8	12.6
13	Eff	Grab	12/14/2004	18	14:00	6.3	2,095	14.7	0.1
14	Eff	Grab	12/14/2004	18	14:00	6.2	2,097	14.8	0.2
15	Eff	Grab	12/14/2004	18	14:00	5.4	2,069	14.8	0.6
16	Eff	Grab	12/14/2004	18	14:00	5.3	2,072	14.8	0.9
17	Eff	Grab	12/14/2004	18	14:00	7.5	2,066	14.8	3.3
18	Eff	Grab	12/14/2004	18	14:00	7.5	2,066	14.7	1.4
Clar	Eff	Grab	12/14/2004	18	14:00	7.2	2,015	13.7	112
Baker	North	Grab	12/14/2004	18	14:00	7.3	2,047	11.8	187
1	Eff	Grab	12/15/2004	18	15:30	7.8	2,064	14.2	0.7
2	Eff	Grab	12/15/2004	18	15:30	7.8	2,067	14.2	0.4
3	Eff	Grab	12/15/2004	18	15:30	6.9	2,049	13.7	5.1
4	Eff	Grab	12/15/2004	18	15:30	6.9	2,052	13.9	6.0
5	Eff	Grab	12/15/2004	18	15:30	7.5	2,022	14.2	0.1
6	Eff	Grab	12/15/2004	18	15:30	7.5	2,024	14.3	0.1
7	Eff	Grab	12/15/2004	18	15:30	8.1	1,983	14.3	0.5
8	Eff	Grab	12/15/2004	18	15:30	8.1	1,983	14.3	0.5
9	Eff	Grab	12/15/2004	18	15:30	7.0	2,052	14.2	8.7
10	Eff	Grab	12/15/2004	18	15:30	7.0	2,055	14.3	9.8
11	Eff	Grab	12/15/2004	18	15:30	8.2	2,084	14.4	8.6
12	Eff	Grab	12/15/2004	18	15:30	8.0	2,083	14.4	9.6
13	Eff	Grab	12/15/2004	18	15:30	6.3	2,091	14.0	0.1
14	Eff	Grab	12/15/2004	18	15:30	6.3	2,092	14.1	0.1
15	Eff	Grab	12/15/2004	18	15:30	-	-	-	1.0
16	Eff	Grab	12/15/2004	18	15:30	-	-	-	1.2

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
17	Eff	Grab	12/15/2004	18	15:30	7.6	2,064	14.1	3.2
18	Eff	Grab	12/15/2004	18	15:30	7.6	2,062	14.1	1.5
1	Eff	Grab	12/15/2004	18	9:00	-	-	-	0.9
2	Eff	Grab	12/15/2004	18	9:00	-	-	-	0.8
3	Eff	Grab	12/15/2004	18	9:00	-	-	-	5.5
4	Eff	Grab	12/15/2004	18	9:00	-	-	-	6.2
5	Eff	Grab	12/15/2004	18	9:00	-	-	-	0.3
6	Eff	Grab	12/15/2004	18	9:00	-	-	-	0.2
7	Eff	Grab	12/15/2004	18	9:00	-	-	-	0.8
8	Eff	Grab	12/15/2004	18	9:00	-	-	-	0.5
9	Eff	Grab	12/15/2004	18	9:00	-	-	-	8.9
10	Eff	Grab	12/15/2004	18	9:00	-	-	-	9.7
11	Eff	Grab	12/15/2004	18	9:00	-	-	-	14.3
12	Eff	Grab	12/15/2004	18	9:00	-	-	-	9.7
13	Eff	Grab	12/15/2004	18	9:00	-	-	-	0.1
14	Eff	Grab	12/15/2004	18	9:00	-	-	-	0.1
15	Eff	Grab	12/15/2004	18	9:00	-	-	-	0.9
16	Eff	Grab	12/15/2004	18	9:00	-	-	-	1.1
17	Eff	Grab	12/15/2004	18	9:00	-	-	-	3.4
18	Eff	Grab	12/15/2004	18	9:00	-	-	-	1.6
Clar	Eff	Grab	12/15/2004	18	9:00	-	-	-	85.1
Baker	North	Grab	12/15/2004	18	9:00	-	-	-	186
1	Eff	Grab	12/16/2004	18	8:45	-	-	-	0.3
2	Eff	Grab	12/16/2004	18	8:45	-	-	-	0.2
3	Eff	Grab	12/16/2004	18	8:45	-	-	-	4.0
4	Eff	Grab	12/16/2004	18	8:45	-	-	-	4.5
5	Eff	Grab	12/16/2004	18	8:45	-	-	-	0.1
6	Eff	Grab	12/16/2004	18	8:45	-	-	-	0.1
7	Eff	Grab	12/16/2004	18	8:45	-	-	-	0.5
8	Eff	Grab	12/16/2004	18	8:45	-	-	-	0.5
9	Eff	Grab	12/16/2004	18	8:45	-	-	-	8.0
10	Eff	Grab	12/16/2004	18	8:45	-	-	-	9.5
11	Eff	Grab	12/16/2004	18	8:45	-	-	-	8.2
12	Eff	Grab	12/16/2004	18	8:45	-	-	-	9.4
13	Eff	Grab	12/16/2004	18	8:45	-	-	-	0.1
14	Eff	Grab	12/16/2004	18	8:45	-	-	-	0.1
15	Eff	Grab	12/16/2004	18	8:45	-	-	-	0.8
16	Eff	Grab	12/16/2004	18	8:45	-	-	-	0.8
17	Eff	Grab	12/16/2004	18	8:45	-	-	-	3.0
18	Eff	Grab	12/16/2004	18	8:45	-	-	-	1.4
Clar	Eff	Grab	12/16/2004	18	8:45	-	-	-	91.3
1	Eff	Grab	12/16/2004	18	18:25	7.4	2,091	13.9	0.4
2	Eff	Grab	12/16/2004	18	18:25	7.5	2,059	13.9	0.2
3	Eff	Grab	12/16/2004	18	18:25	6.9	2,060	14.0	6.8
4	Eff	Grab	12/16/2004	18	18:25	6.9	2,058	14.0	5.5
5	Eff	Grab	12/16/2004	18	18:25	7.1	2,039	13.7	0.3
6	Eff	Grab	12/16/2004	18	18:25	7.1	2,032	13.8	0.3
7	Eff	Grab	12/16/2004	18	18:25	7.3	1,987	13.9	0.5
8	Eff	Grab	12/16/2004	18	18:25	7.3	1,988	13.9	0.6
9	Eff	Grab	12/16/2004	18	18:25	7.3	1,984	13.9	8.3
10	Eff	Grab	12/16/2004	18	18:25	7.0	2,050	14.1	10.2
11	Eff	Grab	12/16/2004	18	18:25	7.7	2,086	14.1	8.0
12	Eff	Grab	12/16/2004	18	18:25	7.7	2,084	13.9	9.0
13	Eff	Grab	12/16/2004	18	18:25	6.4	1,462	13.8	0.2
14	Eff	Grab	12/16/2004	18	18:25	6.2	2,092	13.8	0.1
15	Eff	Grab	12/16/2004	18	18:25	5.4	1,593	13.8	0.7
16	Eff	Grab	12/16/2004	18	18:25	5.4	1,597	13.7	0.8
17	Eff	Grab	12/16/2004	18	18:25	7.3	2,049	13.7	2.5
18	Eff	Grab	12/16/2004	18	18:25	7.4	2,060	13.9	1.5

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
Clar	Eff	Grab	12/16/2004	18	18:25	7.2	1,866	14.1	112
Baker	North	Grab	12/16/2004	18	18:25	7.0	2,046	14.0	191
1	Eff	Grab	12/17/2004	18	8:15	-	-	-	0.7
2	Eff	Grab	12/17/2004	18	8:15	-	-	-	0.3
3	Eff	Grab	12/17/2004	18	8:15	-	-	-	3.7
4	Eff	Grab	12/17/2004	18	8:15	-	-	-	3.4
5	Eff	Grab	12/17/2004	18	8:15	-	-	-	0.1
6	Eff	Grab	12/17/2004	18	8:15	-	-	-	0.1
7	Eff	Grab	12/17/2004	18	8:15	-	-	-	0.7
8	Eff	Grab	12/17/2004	18	8:15	-	-	-	0.7
9	Eff	Grab	12/17/2004	18	8:15	-	-	-	8.0
10	Eff	Grab	12/17/2004	18	8:15	-	-	-	10.9
11	Eff	Grab	12/17/2004	18	8:15	-	-	-	8.5
12	Eff	Grab	12/17/2004	18	8:15	-	-	-	9.5
13	Eff	Grab	12/17/2004	18	8:15	-	-	-	0.1
14	Eff	Grab	12/17/2004	18	8:15	-	-	-	0.1
15	Eff	Grab	12/17/2004	18	8:15	-	-	-	2.9
16	Eff	Grab	12/17/2004	18	8:15	-	-	-	4.2
17	Eff	Grab	12/17/2004	18	8:15	-	-	-	2.6
18	Eff	Grab	12/17/2004	18	8:15	-	-	-	1.8
Clar	Eff	Grab	12/17/2004	18	8:15	-	-	-	104
Baker	North	Grab	12/17/2004	18	8:15	-	-	-	190
1	Eff	Grab	12/17/2004	18	15:20	7.4	2,076	13.3	0.9
2	Eff	Grab	12/17/2004	18	15:20	7.3	2,070	13.3	0.4
3	Eff	Grab	12/17/2004	18	15:20	6.9	2,059	13.3	3.8
4	Eff	Grab	12/17/2004	18	15:20	6.8	1,992	13.2	6.3
5	Eff	Grab	12/17/2004	18	15:20	7.0	2,050	13.2	0.3
6	Eff	Grab	12/17/2004	18	15:20	6.9	2,048	12.8	0.2
7	Eff	Grab	12/17/2004	18	15:20	6.7	2,028	13.4	1.4
8	Eff	Grab	12/17/2004	18	15:20	6.8	2,009	12.6	1.1
9	Eff	Grab	12/17/2004	18	15:20	6.9	2,018	13.2	11.0
10	Eff	Grab	12/17/2004	18	15:20	6.9	2,001	13.2	10.3
11	Eff	Grab	12/17/2004	18	15:20	7.8	2,076	13.2	10.0
12	Eff	Grab	12/17/2004	18	15:20	7.6	2,086	13.4	11.1
13	Eff	Grab	12/17/2004	18	15:20	6.2	2,089	13.3	0.3
14	Eff	Grab	12/17/2004	18	15:20	6.1	2,093	13.3	0.3
15	Eff	Grab	12/17/2004	18	15:20	5.4	2,077	13.4	3.2
16	Eff	Grab	12/17/2004	18	15:20	5.4	2,073	13.4	4.3
17	Eff	Grab	12/17/2004	18	15:20	7.3	2,071	13.5	3.2
18	Eff	Grab	12/17/2004	18	15:20	7.3	2,069	13.6	1.9
Clar	Eff	Grab	12/17/2004	18	15:20	7.1	2,000	12.1	111
Baker	North	Grab	12/17/2004	18	15:20	7.0	1,864	12.2	189
1	Eff	Grab	12/18/2004	18	8:30	-	-	-	0.8
2	Eff	Grab	12/18/2004	18	8:30	-	-	-	0.5
3	Eff	Grab	12/18/2004	18	8:30	-	-	-	3.5
4	Eff	Grab	12/18/2004	18	8:30	-	-	-	5.6
5	Eff	Grab	12/18/2004	18	8:30	-	-	-	0.2
6	Eff	Grab	12/18/2004	18	8:30	-	-	-	0.2
7	Eff	Grab	12/18/2004	18	8:30	-	-	-	1.7
8	Eff	Grab	12/18/2004	18	8:30	-	-	-	1.4
9	Eff	Grab	12/18/2004	18	8:30	-	-	-	14.2
10	Eff	Grab	12/18/2004	18	8:30	-	-	-	15.6
11	Eff	Grab	12/18/2004	18	8:30	-	-	-	9.2
12	Eff	Grab	12/18/2004	18	8:30	-	-	-	10.4
13	Eff	Grab	12/18/2004	18	8:30	-	-	-	0.3
14	Eff	Grab	12/18/2004	18	8:30	-	-	-	-
15	Eff	Grab	12/18/2004	18	8:30	-	-	-	3.8
16	Eff	Grab	12/18/2004	18	8:30	-	-	-	4.4
17	Eff	Grab	12/18/2004	18	8:30	-	-	-	3.5
18	Eff	Grab	12/18/2004	18	8:30	-	-	-	2.1
Clar	Eff	Grab	12/18/2004	18	8:30	-	-	-	105

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
Baker	North	Grab	12/18/2004	18	8:30	-	-	-	186
1	Eff	Grab	12/18/2004	18	16:00	7.4	2,022	12.4	0.7
2	Eff	Grab	12/18/2004	18	16:00	7.5	2,036	12.8	0.3
3	Eff	Grab	12/18/2004	18	16:00	6.9	2,040	13.2	3.4
4	Eff	Grab	12/18/2004	18	16:00	6.9	2,047	13.3	5.3
5	Eff	Grab	12/18/2004	18	16:00	7.0	2,028	13.3	0.2
6	Eff	Grab	12/18/2004	18	16:00	7.0	2,032	13.4	0.2
7	Eff	Grab	12/18/2004	18	16:00	6.7	2,028	13.4	1.5
8	Eff	Grab	12/18/2004	18	16:00	6.7	2,021	13.4	1.3
9	Eff	Grab	12/18/2004	18	16:00	7.0	2,037	13.5	13.1
10	Eff	Grab	12/18/2004	18	16:00	7.1	2,033	13.3	15.3
11	Eff	Grab	12/18/2004	18	16:00	7.9	2,070	13.5	8.6
12	Eff	Grab	12/18/2004	18	16:00	7.6	2,071	13.4	10.4
13	Eff	Grab	12/18/2004	18	16:00	6.2	2,076	13.3	0.1
14	Eff	Grab	12/18/2004	18	16:00	6.2	2,047	13.3	0.2
15	Eff	Grab	12/18/2004	18	16:00	5.5	2,061	13.3	3.0
16	Eff	Grab	12/18/2004	18	16:00	5.3	2,064	13.2	4.0
17	Eff	Grab	12/18/2004	18	16:00	7.3	2,056	13.2	3.4
18	Eff	Grab	12/18/2004	18	16:00	7.3	2,052	13.4	1.6
Clar	Eff	Grab	12/18/2004	18	16:00	7.1	2,061	12.8	125
1	Eff	Grab	12/19/2004	18	9:00	-	-	-	0.5
2	Eff	Grab	12/19/2004	18	9:00	-	-	-	0.3
3	Eff	Grab	12/19/2004	18	9:00	-	-	-	3.2
4	Eff	Grab	12/19/2004	18	9:00	-	-	-	3.8
5	Eff	Grab	12/19/2004	18	9:00	-	-	-	0.1
6	Eff	Grab	12/19/2004	18	9:00	-	-	-	0.2
7	Eff	Grab	12/19/2004	18	9:00	-	-	-	1.2
8	Eff	Grab	12/19/2004	18	9:00	-	-	-	1.7
9	Eff	Grab	12/19/2004	18	9:00	-	-	-	9.9
10	Eff	Grab	12/19/2004	18	9:00	-	-	-	11.9
11	Eff	Grab	12/19/2004	18	9:00	-	-	-	8.7
12	Eff	Grab	12/19/2004	18	9:00	-	-	-	8.5
13	Eff	Grab	12/19/2004	18	9:00	-	-	-	0.2
14	Eff	Grab	12/19/2004	18	9:00	-	-	-	0.1
15	Eff	Grab	12/19/2004	18	9:00	-	-	-	3.4
16	Eff	Grab	12/19/2004	18	9:00	-	-	-	3.9
17	Eff	Grab	12/19/2004	18	9:00	-	-	-	3.4
18	Eff	Grab	12/19/2004	18	9:00	-	-	-	1.9
Clar	Eff	Grab	12/19/2004	18	9:00	-	-	-	115
Baker	North	Grab	12/19/2004	18	9:00	-	-	-	199
1	Eff	Grab	12/19/2004	19	17:45	6.9	2,054	14.0	0.7
2	Eff	Grab	12/19/2004	19	17:45	7.3	1,877	14.1	0.9
3	Eff	Grab	12/19/2004	19	17:45	6.8	2,064	14.2	5.5
4	Eff	Grab	12/19/2004	19	17:45	7.0	1,889	14.0	20.5
5	Eff	Grab	12/19/2004	19	17:45	6.9	1,531	14.0	0.2
6	Eff	Grab	12/19/2004	19	17:45	6.6	2,040	14.1	0.2
7	Eff	Grab	12/19/2004	19	17:45	8.0	2,013	13.5	2.1
8	Eff	Grab	12/19/2004	19	17:45	6.8	1,985	13.5	1.3
9	Eff	Grab	12/19/2004	19	17:45	7.0	1,892	14.1	58.4
10	Eff	Grab	12/19/2004	19	17:45	7.0	1,886	13.9	39.5
11	Eff	Grab	12/19/2004	19	17:45	7.1	1,880	14.2	50.0
12	Eff	Grab	12/19/2004	19	17:45	7.3	1,877	14.1	101
13	Eff	Grab	12/19/2004	19	17:45	-	-	-	-
14	Eff	Grab	12/19/2004	19	17:45	6.2	1,973	14.0	0.5
15	Eff	Grab	12/19/2004	19	17:45	5.4	1,950	14.2	5.0
16	Eff	Grab	12/19/2004	19	17:45	5.4	2,020	13.8	2.0
17	Eff	Grab	12/19/2004	19	17:45	-	-	-	-
18	Eff	Grab	12/19/2004	19	17:45	7.2	1,700	14.0	41.8
Clar	Eff	Grab	12/19/2004	19	17:45	7.1	1,868	12.7	565
Baker	South	Grab	12/19/2004	19	17:45	7.2	1,869	10.3	852

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
1	Eff	Grab	12/20/2004	19	8:30	-	-	-	0.4
2	Eff	Grab	12/20/2004	19	8:30	-	-	-	6.7
3	Eff	Grab	12/20/2004	19	8:30	-	-	-	1.7
4	Eff	Grab	12/20/2004	19	8:30	-	-	-	87.3
5	Eff	Grab	12/20/2004	19	8:30	-	-	-	4.4
6	Eff	Grab	12/20/2004	19	8:30	-	-	-	0.3
7	Eff	Grab	12/20/2004	19	8:30	-	-	-	92.1
8	Eff	Grab	12/20/2004	19	8:30	-	-	-	71.0
9	Eff	Grab	12/20/2004	19	8:30	-	-	-	191
10	Eff	Grab	12/20/2004	19	8:30	-	-	-	194
11	Eff	Grab	12/20/2004	19	8:30	-	-	-	200
12	Eff	Grab	12/20/2004	19	8:30	-	-	-	209
13	Eff	Grab	12/20/2004	19	8:30	-	-	-	0.3
14	Eff	Grab	12/20/2004	19	8:30	-	-	-	0.4
15	Eff	Grab	12/20/2004	19	8:30	-	-	-	2.3
16	Eff	Grab	12/20/2004	19	8:30	-	-	-	2.1
17	Eff	Grab	12/20/2004	19	8:30	-	-	-	5.0
18	Eff	Grab	12/20/2004	19	8:30	-	-	-	107
Clar	Eff	Grab	12/20/2004	19	8:30	-	-	-	572
Baker	South	Grab	12/20/2004	19	8:30	-	-	-	851
1	Eff	Grab	12/20/2004	19	13:00	7.5	1,915	13.5	0.5
2	Eff	Grab	12/20/2004	19	13:00	7.4	1,924	13.4	2.3
3	Eff	Grab	12/20/2004	19	13:00	6.7	1,879	13.3	2.7
4	Eff	Grab	12/20/2004	19	13:00	6.8	1,866	13.2	85.0
5	Eff	Grab	12/20/2004	19	13:00	7.2	1,902	13.0	11.2
6	Eff	Grab	12/20/2004	19	13:00	7.1	1,887	13.4	0.2
7	Eff	Grab	12/20/2004	19	13:00	6.7	1,885	13.2	109
8	Eff	Grab	12/20/2004	19	13:00	6.5	1,886	13.2	75.8
9	Eff	Grab	12/20/2004	19	13:00	6.9	1,864	13.3	188
10	Eff	Grab	12/20/2004	19	13:00	7.0	1,868	13.3	194
11	Eff	Grab	12/20/2004	19	13:00	7.9	1,881	13.4	199
12	Eff	Grab	12/20/2004	19	13:00	7.6	1,883	13.4	213
13	Eff	Grab	12/20/2004	19	13:00	6.2	1,979	13.2	0.3
14	Eff	Grab	12/20/2004	19	13:00	6.1	1,924	13.2	0.2
15	Eff	Grab	12/20/2004	19	13:00	5.9	1,881	13.1	2.3
16	Eff	Grab	12/20/2004	19	13:00	5.9	1,894	13.4	1.7
17	Eff	Grab	12/20/2004	19	13:00	7.4	1,923	13.5	5.9
18	Eff	Grab	12/20/2004	19	13:00	7.2	1,876	13.4	110
Clar	Eff	Grab	12/20/2004	19	13:00	7.1	1,879	12.5	612
Baker	South	Grab	12/20/2004	19	13:00	7.3	1,867	13.4	844
1	Eff	Comp	12/21/2004	19	8:00	7.5	1,862	13.9	12.3
2	Eff	Comp	12/21/2004	19	8:00	7.5	1,863	13.7	8.0
3	Eff	Comp	12/21/2004	19	8:00	7.2	1,858	13.6	116
4	Eff	Comp	12/21/2004	19	8:00	7.1	1,870	13.7	112
5	Eff	Comp	12/21/2004	19	8:00	7.3	1,858	13.7	24.4
6	Eff	Comp	12/21/2004	19	8:00	7.3	1,880	13.7	2.6
7	Eff	Comp	12/21/2004	19	8:00	6.8	1,865	13.8	95.9
8	Eff	Comp	12/21/2004	19	8:00	6.8	1,875	13.8	57.9
9	Eff	Comp	12/21/2004	19	8:00	7.1	1,863	13.7	156
10	Eff	Comp	12/21/2004	19	8:00	7.1	1,861	13.8	157
11	Eff	Comp	12/21/2004	19	8:00	7.7	1,881	13.8	175
12	Eff	Comp	12/21/2004	19	8:00	7.7	1,884	13.8	184
13	Eff	Comp	12/21/2004	19	8:00	6.3	1,932	13.8	0.3
14	Eff	Comp	12/21/2004	19	8:00	6.3	1,899	13.9	2.0
15	Eff	Comp	12/21/2004	19	8:00	5.9	1,884	13.8	1.0
16	Eff	Comp	12/21/2004	19	8:00	5.9	1,882	13.6	1.3
17	Eff	Comp	12/21/2004	19	8:00	7.5	1,882	13.7	108
18	Eff	Comp	12/21/2004	19	8:00	7.5	1,885	13.8	96.3
Clar	Eff	Comp	12/21/2004	19	8:00	7.3	1,863	14.0	584
Baker	South	Grab	12/21/2004	19	8:00	7.5	1,849	11.8	848

Table B-21 Continued, 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
1	Twelve	Grab	12/21/2004	19	11:00	-	-	-	101
2	Twelve	Grab	12/21/2004	19	11:00	-	-	-	86.0
3	Twelve	Grab	12/21/2004	19	11:00	-	-	-	284
4	Twelve	Grab	12/21/2004	19	11:00	-	-	-	179
5	Twelve	Grab	12/21/2004	19	11:00	-	-	-	170
6	Twelve	Grab	12/21/2004	19	11:00	-	-	-	210
7	Twelve	Grab	12/21/2004	19	11:00	-	-	-	277
8	Twelve	Grab	12/21/2004	19	11:00	-	-	-	172
9	Twelve	Grab	12/21/2004	19	11:00	-	-	-	197
10	Twelve	Grab	12/21/2004	19	11:00	-	-	-	224
11	Twelve	Grab	12/21/2004	19	11:00	-	-	-	280
12	Twelve	Grab	12/21/2004	19	11:00	-	-	-	262
13	Twelve	Grab	12/21/2004	19	11:00	-	-	-	39.1
14	Twelve	Grab	12/21/2004	19	11:00	-	-	-	20.0
15	Twelve	Grab	12/21/2004	19	11:00	-	-	-	2.2
16	Twelve	Grab	12/21/2004	19	11:00	-	-	-	6.5
17	Twelve	Grab	12/21/2004	19	11:00	-	-	-	213
18	Twelve	Grab	12/21/2004	19	11:00	-	-	-	159
C1-C4	Interface	C/G	12/21/2004	19	13:00	-	-	-	2142
C5-C12	Interface	C/G	12/21/2004	19	13:00	-	-	-	441
C13-C18	Interface	C/G	12/21/2004	19	13:00	-	-	-	324
1	Eff	Grab	12/22/2004	19	8:45	-	-	-	36.1
2	Eff	Grab	12/22/2004	19	8:45	-	-	-	28.3
3	Eff	Grab	12/22/2004	19	8:45	-	-	-	140
4	Eff	Grab	12/22/2004	19	8:45	-	-	-	159
5	Eff	Grab	12/22/2004	19	8:45	-	-	-	32.4
6	Eff	Grab	12/22/2004	19	8:45	-	-	-	23.8
7	Eff	Grab	12/22/2004	19	8:45	-	-	-	88.0
8	Eff	Grab	12/22/2004	19	8:45	-	-	-	120
9	Eff	Grab	12/22/2004	19	8:45	-	-	-	122
10	Eff	Grab	12/22/2004	19	8:45	-	-	-	136
11	Eff	Grab	12/22/2004	19	8:45	-	-	-	145
12	Eff	Grab	12/22/2004	19	8:45	-	-	-	153
13	Eff	Grab	12/22/2004	19	8:45	-	-	-	0.5
14	Eff	Grab	12/22/2004	19	8:45	-	-	-	0.4
15	Eff	Grab	12/22/2004	19	8:45	-	-	-	1.9
16	Eff	Grab	12/22/2004	19	8:45	-	-	-	2.4
17	Eff	Grab	12/22/2004	19	8:45	-	-	-	98.1
18	Eff	Grab	12/22/2004	19	8:45	-	-	-	93.4
1	Eff	Grab	12/22/2004	19	14:30	7.9	1,877	12.5	36.9
2	Eff	Grab	12/22/2004	19	14:30	7.9	1,877	12.3	31.9
3	Eff	Grab	12/22/2004	19	14:30	7.3	1,864	13.2	138
4	Eff	Grab	12/22/2004	19	14:30	7.2	1,864	13.1	158
5	Eff	Grab	12/22/2004	19	14:30	7.9	1,868	12.5	34.6
6	Eff	Grab	12/22/2004	19	14:30	7.8	1,865	12.7	27.2
7	Eff	Grab	12/22/2004	19	14:30	7.1	1,846	12.7	82.4
8	Eff	Grab	12/22/2004	19	14:30	6.8	1,863	12.6	129
9	Eff	Grab	12/22/2004	19	14:30	7.1	1,865	12.7	120
10	Eff	Grab	12/22/2004	19	14:30	7.2	1,864	13.2	133
11	Eff	Grab	12/22/2004	19	14:30	8.6	1,885	13.1	138
12	Eff	Grab	12/22/2004	19	14:30	8.3	1,885	12.7	145
13	Eff	Grab	12/22/2004	19	14:30	6.5	1,886	13.0	0.6
14	Eff	Grab	12/22/2004	19	14:30	6.6	1,882	12.4	2.4
15	Eff	Grab	12/22/2004	19	14:30	5.9	1,881	13.0	2.4
16	Eff	Grab	12/22/2004	19	14:30	5.9	1,878	13.1	3.5
17	Eff	Grab	12/22/2004	19	14:30	7.8	1,878	12.1	188
18	Eff	Grab	12/22/2004	19	14:30	7.8	1,876	12.4	87.6
Clar	Eff	Grab	12/22/2004	19	14:30	7.5	1,863	11.7	607
Baker	South	Grab	12/22/2004	19	14:30	-	-	-	855
1	Eff	Grab	12/23/2004	19	13:10	-	-	-	32.9

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
2	Eff	Grab	12/23/2004	19	13:10	-	-	-	28.6
3	Eff	Grab	12/23/2004	19	13:10	-	-	-	110
4	Eff	Grab	12/23/2004	19	13:10	-	-	-	131
5	Eff	Grab	12/23/2004	19	13:10	-	-	-	32.7
6	Eff	Grab	12/23/2004	19	13:10	-	-	-	33.3
7	Eff	Grab	12/23/2004	19	13:10	-	-	-	69.1
8	Eff	Grab	12/23/2004	19	13:10	-	-	-	120
9	Eff	Grab	12/23/2004	19	13:10	-	-	-	98.0
10	Eff	Grab	12/23/2004	19	13:10	-	-	-	110
11	Eff	Grab	12/23/2004	19	13:10	-	-	-	105
12	Eff	Grab	12/23/2004	19	13:10	-	-	-	114
13	Eff	Grab	12/23/2004	19	13:10	-	-	-	0.6
14	Eff	Grab	12/23/2004	19	13:10	-	-	-	0.4
15	Eff	Grab	12/23/2004	19	13:10	-	-	-	2.5
16	Eff	Grab	12/23/2004	19	13:10	-	-	-	3.9
17	Eff	Grab	12/23/2004	19	13:10	-	-	-	95.1
18	Eff	Grab	12/23/2004	19	13:10	-	-	-	81.5
1	Eff	Grab	12/23/2004	19	9:00	7.9	1,880	8.4	33.0
2	Eff	Grab	12/23/2004	19	9:00	8.0	1,883	8.4	28.9
3	Eff	Grab	12/23/2004	19	9:00	7.2	1,891	8.6	122
4	Eff	Grab	12/23/2004	19	9:00	7.4	1,886	8.6	142
5	Eff	Grab	12/23/2004	19	9:00	7.9	1,883	8.6	39.2
6	Eff	Grab	12/23/2004	19	9:00	7.8	1,891	8.7	33.5
7	Eff	Grab	12/23/2004	19	9:00	7.7	1,857	8.8	79.7
8	Eff	Grab	12/23/2004	19	9:00	7.4	1,857	8.8	125
9	Eff	Grab	12/23/2004	19	9:00	7.4	1,898	8.9	111
10	Eff	Grab	12/23/2004	19	9:00	7.4	1,895	8.2	120
11	Eff	Grab	12/23/2004	19	9:00	8.7	1,903	9.8	132
12	Eff	Grab	12/23/2004	19	9:00	8.4	1,913	8.1	125
13	Eff	Grab	12/23/2004	19	9:00	6.6	1,895	8.4	0.6
14	Eff	Grab	12/23/2004	19	9:00	6.6	1,895	8.4	0.6
15	Eff	Grab	12/23/2004	19	9:00	5.7	1,902	8.4	2.2
16	Eff	Grab	12/23/2004	19	9:00	5.6	1,907	8.3	2.9
17	Eff	Grab	12/23/2004	19	9:00	7.7	1,888	8.2	97.4
18	Eff	Grab	12/23/2004	19	9:00	7.7	1,895	8.1	84.9
Clar	Eff	Grab	12/23/2004	19	9:00	7.6	1,926	7.4	595
Baker	South	Grab	12/23/2004	19	9:00	7.6	2,014	7.4	821
1	Eff	Grab	3/13/2005	20	19:00	7.7	2,032	11.2	1.4
2	Eff	Grab	3/13/2005	20	19:00	7.8	2,070	11.1	0.7
3	Eff	Grab	3/13/2005	20	19:00	7.4	2,880	11.0	72.6
4	Eff	Grab	3/13/2005	20	19:00	7.3	2,832	10.9	76.3
5	Eff	Grab	3/13/2005	20	19:00	7.8	2,988	10.8	24.8
6	Eff	Grab	3/13/2005	20	19:00	7.8	2,988	10.8	22.3
7	Eff	Grab	3/13/2005	20	19:00	8.2	2,921	10.8	95.1
8	Eff	Grab	3/13/2005	20	19:00	8.1	2,982	10.8	94.1
9	Eff	Grab	3/13/2005	20	19:00	7.3	3,009	10.9	42.5
10	Eff	Grab	3/13/2005	20	19:00	7.3	3,008	11.0	42.6
11	Eff	Grab	3/13/2005	20	19:00	8.1	3,031	11.0	64.3
12	Eff	Grab	3/13/2005	20	19:00	8.1	3,044	11.0	82.4
13	Eff	Grab	3/13/2005	20	19:00	7.1	3,030	11.1	0.4
14	Eff	Grab	3/13/2005	20	19:00	7.0	2,991	11.1	0.4
15	Eff	Grab	3/13/2005	20	19:00	6.3	3,009	11.2	0.5
16	Eff	Grab	3/13/2005	20	19:00	6.2	3,035	11.1	1.8
17	Eff	Grab	3/13/2005	20	19:00	7.7	3,027	11.1	108
18	Eff	Grab	3/13/2005	20	19:00	7.7	2,809	11.2	40.1
Clar	Eff	Grab	3/13/2005	20	19:00	7.6	2,990	10.5	427
Baker	South	Grab	3/13/2005	20	19:00	-	-	-	-
Limestone	Eff	Grab	3/13/2005	20	19:00	8.2	2,616	10.7	8.0
1	Eff	Grab	3/14/2005	20	8:30	-	-	-	0.5
2	Eff	Grab	3/14/2005	20	8:30	-	-	-	0.7
3	Eff	Grab	3/14/2005	20	8:30	-	-	-	157

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
4	Eff	Grab	3/14/2005	20	8:30	-	-	-	151
5	Eff	Grab	3/14/2005	20	8:30	-	-	-	37.0
6	Eff	Grab	3/14/2005	20	8:30	-	-	-	26.2
7	Eff	Grab	3/14/2005	20	8:30	-	-	-	104
8	Eff	Grab	3/14/2005	20	8:30	-	-	-	97.2
9	Eff	Grab	3/14/2005	20	8:30	-	-	-	116
10	Eff	Grab	3/14/2005	20	8:30	-	-	-	114
11	Eff	Grab	3/14/2005	20	8:30	-	-	-	103
12	Eff	Grab	3/14/2005	20	8:30	-	-	-	112
13	Eff	Grab	3/14/2005	20	8:30	-	-	-	0.3
14	Eff	Grab	3/14/2005	20	8:30	-	-	-	0.3
15	Eff	Grab	3/14/2005	20	8:30	-	-	-	4.3
16	Eff	Grab	3/14/2005	20	8:30	-	-	-	4.6
17	Eff	Grab	3/14/2005	20	8:30	-	-	-	124
18	Eff	Grab	3/14/2005	20	8:30	-	-	-	128
Clar	Eff	Grab	3/14/2005	20	8:30	-	-	-	501
Baker	South	Grab	3/14/2005	20	8:30	-	-	-	-
Limestone	Eff	Grab	3/14/2005	20	8:30	-	-	-	10.9
1	Eff	Grab	3/14/2005	20	17:00	-	-	-	off
2	Eff	Grab	3/14/2005	20	17:00	-	-	-	off
3	Eff	Grab	3/14/2005	20	17:00	7.3	3,016	10.8	162
4	Eff	Grab	3/14/2005	20	17:00	7.3	3,018	10.7	153
5	Eff	Grab	3/14/2005	20	17:00	7.8	3,013	10.6	33.9
6	Eff	Grab	3/14/2005	20	17:00	7.8	3,008	10.4	29.0
7	Eff	Grab	3/14/2005	20	17:00	7.8	3,002	10.7	97.9
8	Eff	Grab	3/14/2005	20	17:00	7.9	2,999	10.7	97.0
9	Eff	Grab	3/14/2005	20	17:00	7.1	3,011	10.7	124
10	Eff	Grab	3/14/2005	20	17:00	7.2	3,008	10.7	125
11	Eff	Grab	3/14/2005	20	17:00	8.4	3,040	10.9	107
12	Eff	Grab	3/14/2005	20	17:00	8.2	3,039	10.8	116
13	Eff	Grab	3/14/2005	20	17:00	6.7	3,044	10.6	0.6
14	Eff	Grab	3/14/2005	20	17:00	6.6	3,044	10.6	0.3
15	Eff	Grab	3/14/2005	20	17:00	5.7	3,034	10.6	3.7
16	Eff	Grab	3/14/2005	20	17:00	5.6	3,039	10.5	5.5
17	Eff	Grab	3/14/2005	20	17:00	7.6	3,023	10.6	121
18	Eff	Grab	3/14/2005	20	17:00	7.6	3,026	10.7	131
Clar	Eff	Grab	3/14/2005	20	17:00	7.2	2,973	7.6	463
Baker	South	Grab	3/14/2005	20	17:00	7.2	3,013	7.6	1765
Limestone	Eff	Grab	3/14/2005	20	17:00	8.8	3,026	10.7	12.5
1	Twelve	Grab	3/15/2005	20	11:30	-	-	-	5.8
2	Twelve	Grab	3/15/2005	20	11:30	-	-	-	98.5
3	Twelve	Grab	3/15/2005	20	11:30	-	-	-	225
4	Twelve	Grab	3/15/2005	20	11:30	-	-	-	250
5	Twelve	Grab	3/15/2005	20	11:30	-	-	-	138
6	Twelve	Grab	3/15/2005	20	11:30	-	-	-	102
7	Twelve	Grab	3/15/2005	20	11:30	-	-	-	192
8	Twelve	Grab	3/15/2005	20	11:30	-	-	-	139
9	Twelve	Grab	3/15/2005	20	11:30	-	-	-	201
10	Twelve	Grab	3/15/2005	20	11:30	-	-	-	213
11	Twelve	Grab	3/15/2005	20	11:30	-	-	-	210
12	Twelve	Grab	3/15/2005	20	11:30	-	-	-	193
13	Twelve	Grab	3/15/2005	20	11:30	-	-	-	1.3
14	Twelve	Grab	3/15/2005	20	11:30	-	-	-	0.7
15	Twelve	Grab	3/15/2005	20	11:30	-	-	-	64.8
16	Twelve	Grab	3/15/2005	20	11:30	-	-	-	137
17	Twelve	Grab	3/15/2005	20	11:30	-	-	-	159
18	Twelve	Grab	3/15/2005	20	11:30	-	-	-	190
Limestone	6"	Grab	3/15/2005	20	11:30	-	-	-	21.5
F1	Interface	C/G	3/15/2005	20	11:30	-	-	-	1464
F2	Interface	C/G	3/15/2005	20	11:30	-	-	-	403
F3	Interface	C/G	3/15/2005	20	11:30	-	-	-	1121

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
F6	Interface	C/G	3/15/2005	20	11:30	-	-	-	399
1	Eff	Comp	3/15/2005	20	8:00	7.8	2,564	8.5	0.9
2	Eff	Comp	3/15/2005	20	8:00	7.9	2,724	8.6	1.4
3	Eff	Comp	3/15/2005	20	8:00	7.4	3,009	9.0	139
4	Eff	Comp	3/15/2005	20	8:00	7.4	3,004	9.0	137
5	Eff	Comp	3/15/2005	20	8:00	7.9	2,987	8.9	32.6
6	Eff	Comp	3/15/2005	20	8:00	7.9	2,993	8.9	25.1
7	Eff	Comp	3/15/2005	20	8:00	8.0	2,984	8.9	87.8
8	Eff	Comp	3/15/2005	20	8:00	8.0	2,990	8.8	84.7
9	Eff	Comp	3/15/2005	20	8:00	7.2	3,004	9.2	113
10	Eff	Comp	3/15/2005	20	8:00	7.3	3,002	9.3	118
11	Eff	Comp	3/15/2005	20	8:00	8.3	3,037	9.4	94.9
12	Eff	Comp	3/15/2005	20	8:00	8.2	3,035	9.3	105
13	Eff	Comp	3/15/2005	20	8:00	6.5	3,042	9.0	0.2
14	Eff	Comp	3/15/2005	20	8:00	6.5	3,041	9.2	0.7
15	Eff	Comp	3/15/2005	20	8:00	5.9	3,033	9.4	3.5
16	Eff	Comp	3/15/2005	20	8:00	5.6	3,039	9.3	7.7
17	Eff	Comp	3/15/2005	20	8:00	7.6	3,010	9.2	108
18	Eff	Comp	3/15/2005	20	8:00	7.6	3,010	9.3	121
Clar	Eff	Comp	3/15/2005	20	8:00	7.3	3,046	7.1	407
Baker	South	Comp	3/15/2005	20	8:00	7.3	3,022	7.1	1758
Limestone	Eff	Comp	3/15/2005	20	8:00	8.6	3,010	9.3	8.6
1	Eff	Grab	3/15/2005	20	17:00	-	-	-	3.1
2	Eff	Grab	3/15/2005	20	17:00	-	-	-	6.5
3	Eff	Grab	3/15/2005	20	17:00	-	-	-	147
4	Eff	Grab	3/15/2005	20	17:00	-	-	-	155
5	Eff	Grab	3/15/2005	20	17:00	-	-	-	28.3
6	Eff	Grab	3/15/2005	20	17:00	-	-	-	23.7
7	Eff	Grab	3/15/2005	20	17:00	-	-	-	150
8	Eff	Grab	3/15/2005	20	17:00	-	-	-	75.8
9	Eff	Grab	3/15/2005	20	17:00	-	-	-	109
10	Eff	Grab	3/15/2005	20	17:00	-	-	-	119
11	Eff	Grab	3/15/2005	20	17:00	-	-	-	93.8
12	Eff	Grab	3/15/2005	20	17:00	-	-	-	124
13	Eff	Grab	3/15/2005	20	17:00	-	-	-	2.9
14	Eff	Grab	3/15/2005	20	17:00	-	-	-	2.1
15	Eff	Grab	3/15/2005	20	17:00	-	-	-	4.9
16	Eff	Grab	3/15/2005	20	17:00	-	-	-	12.9
17	Eff	Grab	3/15/2005	20	17:00	-	-	-	116
18	Eff	Grab	3/15/2005	20	17:00	-	-	-	120
Clar	Eff	Grab	3/15/2005	20	17:00	-	-	-	506
Baker	South	Grab	3/15/2005	20	17:00	-	-	-	1753
Limestone	Eff	Grab	3/15/2005	20	17:00	-	-	-	6.7
1	Eff	Grab	3/16/2005	20	8:30	-	-	-	0.4
2	Eff	Grab	3/16/2005	20	8:30	-	-	-	31.0
3	Eff	Grab	3/16/2005	20	8:30	-	-	-	166
4	Eff	Grab	3/16/2005	20	8:30	-	-	-	164
5	Eff	Grab	3/16/2005	20	8:30	-	-	-	36.0
6	Eff	Grab	3/16/2005	20	8:30	-	-	-	32.7
7	Eff	Grab	3/16/2005	20	8:30	-	-	-	103
8	Eff	Grab	3/16/2005	20	8:30	-	-	-	93.2
9	Eff	Grab	3/16/2005	20	8:30	-	-	-	112
10	Eff	Grab	3/16/2005	20	8:30	-	-	-	118
11	Eff	Grab	3/16/2005	20	8:30	-	-	-	115
12	Eff	Grab	3/16/2005	20	8:30	-	-	-	125
13	Eff	Grab	3/16/2005	20	8:30	-	-	-	0.3
14	Eff	Grab	3/16/2005	20	8:30	-	-	-	0.4
15	Eff	Grab	3/16/2005	20	8:30	-	-	-	4.7
16	Eff	Grab	3/16/2005	20	8:30	-	-	-	31.2
17	Eff	Grab	3/16/2005	20	8:30	-	-	-	139

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
18	Eff	Grab	3/16/2005	20	8:30	-	-	-	157
Clar	Eff	Grab	3/16/2005	20	8:30	-	-	-	608
Baker	South	Grab	3/16/2005	20	8:30	-	-	-	1761
Limestone	Eff	Grab	3/16/2005	20	8:30	-	-	-	16.2
1	Eff	Grab	3/16/2005	20	16:30	8.0	1,843	10.6	0.2
2	Eff	Grab	3/16/2005	20	16:30	8.1	3,023	10.6	3.8
3	Eff	Grab	3/16/2005	20	16:30	7.2	3000	10.5	200
4	Eff	Grab	3/16/2005	20	16:30	7.2	3019	10.4	190
5	Eff	Grab	3/16/2005	20	16:30	8.1	3005	10.3	42.0
6	Eff	Grab	3/16/2005	20	16:30	8.0	3013	10.4	40.5
7	Eff	Grab	3/16/2005	20	16:30	8.2	3007	10.4	115
8	Eff	Grab	3/16/2005	20	16:30	8.3	3009	10.4	111
9	Eff	Grab	3/16/2005	20	16:30	7.2	3008	10.5	134
10	Eff	Grab	3/16/2005	20	16:30	7.2	3012	10.5	159
11	Eff	Grab	3/16/2005	20	16:30	8.4	3028	10.5	130
12	Eff	Grab	3/16/2005	20	16:30	8.4	3030	10.5	140
13	Eff	Grab	3/16/2005	20	16:30	6.8	3043	10.5	0.2
14	Eff	Grab	3/16/2005	20	16:30	6.7	3050	10.5	0.2
15	Eff	Grab	3/16/2005	20	16:30	5.8	3044	10.5	8.0
16	Eff	Grab	3/16/2005	20	16:30	5.7	3044	10.5	46.6
17	Eff	Grab	3/16/2005	20	16:30	7.7	3024	10.3	154
18	Eff	Grab	3/16/2005	20	16:30	7.7	3015	10.3	177
Clar	Eff	Grab	3/16/2005	20	16:30	7.3	3006	10.1	624
Baker	South	Grab	3/16/2005	20	16:30	7.3	3009	9.8	1745
Limestone	Eff	Grab	3/16/2005	20	16:30	8.9	3030	10.6	22.1
1	Eff	Grab	3/17/2005	20	8:30	-	-	-	66.1
2	Eff	Grab	3/17/2005	20	8:30	-	-	-	35.0
3	Eff	Grab	3/17/2005	20	8:30	-	-	-	193
4	Eff	Grab	3/17/2005	20	8:30	-	-	-	192
5	Eff	Grab	3/17/2005	20	8:30	-	-	-	38.1
6	Eff	Grab	3/17/2005	20	8:30	-	-	-	45.9
7	Eff	Grab	3/17/2005	20	8:30	-	-	-	113
8	Eff	Grab	3/17/2005	20	8:30	-	-	-	104
9	Eff	Grab	3/17/2005	20	8:30	-	-	-	118
10	Eff	Grab	3/17/2005	20	8:30	-	-	-	137
11	Eff	Grab	3/17/2005	20	8:30	-	-	-	143
12	Eff	Grab	3/17/2005	20	8:30	-	-	-	153
13	Eff	Grab	3/17/2005	20	8:30	-	-	-	0.3
14	Eff	Grab	3/17/2005	20	8:30	-	-	-	0.2
15	Eff	Grab	3/17/2005	20	8:30	-	-	-	20.6
16	Eff	Grab	3/17/2005	20	8:30	-	-	-	108
17	Eff	Grab	3/17/2005	20	8:30	-	-	-	166
18	Eff	Grab	3/17/2005	20	8:30	-	-	-	177
Clar	Eff	Grab	3/17/2005	20	8:30	-	-	-	700
Baker	South	Grab	3/17/2005	20	8:30	-	-	-	1770
Limestone	Eff	Grab	3/17/2005	20	8:30	-	-	-	26.2
1	Eff	Grab	3/17/2005	20	16:30	8.2	3015	10.5	85.5
2	Eff	Grab	3/17/2005	20	16:30	8.1	3016	10.5	52.7
3	Eff	Grab	3/17/2005	20	16:30	7.3	3002	10.3	220
4	Eff	Grab	3/17/2005	20	16:30	7.3	3008	10.3	215
5	Eff	Grab	3/17/2005	20	16:30	8.1	3011	10.5	34.3
6	Eff	Grab	3/17/2005	20	16:30	8.0	3018	10.6	48.5
7	Eff	Grab	3/17/2005	20	16:30	8.3	3007	10.5	119
8	Eff	Grab	3/17/2005	20	16:30	8.3	3013	10.5	114
9	Eff	Grab	3/17/2005	20	16:30	7.3	3013	10.3	119
10	Eff	Grab	3/17/2005	20	16:30	7.4	3010	10.4	180
11	Eff	Grab	3/17/2005	20	16:30	8.5	3040	10.6	162
12	Eff	Grab	3/17/2005	20	16:30	8.4	3038	10.4	158
13	Eff	Grab	3/17/2005	20	16:30	6.8	3047	10.6	0.4
14	Eff	Grab	3/17/2005	20	16:30	6.6	3045	10.7	0.4
15	Eff	Grab	3/17/2005	20	16:30	6.0	3041	10.6	42.0

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
16	Eff	Grab	3/17/2005	20	16:30	5.8	3044	10.5	148
17	Eff	Grab	3/17/2005	20	16:30	7.9	3018	10.3	184
18	Eff	Grab	3/17/2005	20	16:30	7.8	3014	10.4	188
Clar	Eff	Grab	3/17/2005	20	16:30	7.7	3020	10.6	664
Baker	South	Grab	3/17/2005	20	16:30	7.6	3025	10.2	1857
Limestone	Eff	Grab	3/17/2005	20	16:30	8.8	3019	10.6	28.5
1	Eff	Grab	3/18/2005	20	9:00	-	-	-	91.5
2	Eff	Grab	3/18/2005	20	9:00	-	-	-	89.2
3	Eff	Grab	3/18/2005	20	9:00	-	-	-	234
4	Eff	Grab	3/18/2005	20	9:00	-	-	-	237
5	Eff	Grab	3/18/2005	20	9:00	-	-	-	18.9
6	Eff	Grab	3/18/2005	20	9:00	-	-	-	57.0
7	Eff	Grab	3/18/2005	20	9:00	-	-	-	132
8	Eff	Grab	3/18/2005	20	9:00	-	-	-	123
9	Eff	Grab	3/18/2005	20	9:00	-	-	-	87.6
10	Eff	Grab	3/18/2005	20	9:00	-	-	-	129
11	Eff	Grab	3/18/2005	20	9:00	-	-	-	186
12	Eff	Grab	3/18/2005	20	9:00	-	-	-	185
13	Eff	Grab	3/18/2005	20	9:00	-	-	-	2.2
14	Eff	Grab	3/18/2005	20	9:00	-	-	-	1.5
15	Eff	Grab	3/18/2005	20	9:00	-	-	-	148
16	Eff	Grab	3/18/2005	20	9:00	-	-	-	238
17	Eff	Grab	3/18/2005	20	9:00	-	-	-	202
18	Eff	Grab	3/18/2005	20	9:00	-	-	-	208
Clar	Eff	Grab	3/18/2005	20	9:00	-	-	-	741
Baker	South	Grab	3/18/2005	20	9:00	-	-	-	1658
Limestone	Eff	Grab	3/18/2005	20	9:00	-	-	-	7.0
1	Eff	Grab	3/18/2005	20	16:00	8.1	3022	10.4	105
2	Eff	Grab	3/18/2005	20	16:00	8.1	3018	10.3	96.2
3	Eff	Grab	3/18/2005	20	16:00	7.3	3024	10.4	238
4	Eff	Grab	3/18/2005	20	16:00	7.3	3020	10.4	276
5	Eff	Grab	3/18/2005	20	16:00	8.2	3041	10.6	11.6
6	Eff	Grab	3/18/2005	20	16:00	8.2	3022	10.4	64.3
7	Eff	Grab	3/18/2005	20	16:00	8.3	3014	10.5	141
8	Eff	Grab	3/18/2005	20	16:00	8.3	3016	10.5	147
9	Eff	Grab	3/18/2005	20	16:00	7.2	2910	10.4	84.5
10	Eff	Grab	3/18/2005	20	16:00	7.3	2792	10.4	222
11	Eff	Grab	3/18/2005	20	16:00	8.5	3041	10.7	194
12	Eff	Grab	3/18/2005	20	16:00	8.3	3044	10.6	201
13	Eff	Grab	3/18/2005	20	16:00	6.8	3040	10.5	0.6
14	Eff	Grab	3/18/2005	20	16:00	6.6	3041	10.6	0.6
15	Eff	Grab	3/18/2005	20	16:00	5.8	3044	10.6	220
16	Eff	Grab	3/18/2005	20	16:00	5.7	3046	10.6	297
17	Eff	Grab	3/18/2005	20	16:00	7.7	3013	10.4	225
18	Eff	Grab	3/18/2005	20	16:00	7.7	3019	10.5	226
Clar	Eff	Grab	3/18/2005	20	16:00	7.5	3038	10.5	1048
Baker	South	Grab	3/18/2005	20	16:00	7.5	3020	10.9	1643
Limestone	Eff	Grab	3/18/2005	20	16:00	8.9	3030	10.5	35.9
1	Eff	Grab	3/19/2005	20	8:00	8.2	3011	8.7	119
2	Eff	Grab	3/19/2005	20	8:00	8.2	3003	8.7	113
3	Eff	Grab	3/19/2005	20	8:00	7.3	2903	8.7	245
4	Eff	Grab	3/19/2005	20	8:00	7.2	2950	8.6	280
5	Eff	Grab	3/19/2005	20	8:00	8.2	3011	8.7	44.3
6	Eff	Grab	3/19/2005	20	8:00	8.1	3013	8.7	61.1
7	Eff	Grab	3/19/2005	20	8:00	8.4	3008	8.7	145
8	Eff	Grab	3/19/2005	20	8:00	8.4	3014	8.8	155
9	Eff	Grab	3/19/2005	20	8:00	7.4	3005	8.5	220
10	Eff	Grab	3/19/2005	20	8:00	7.5	3016	8.5	220
11	Eff	Grab	3/19/2005	20	8:00	8.6	3051	8.8	217
12	Eff	Grab	3/19/2005	20	8:00	8.4	3050	8.8	193
13	Eff	Grab	3/19/2005	20	8:00	6.9	3039	9.5	1.7

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
14	Eff	Grab	3/19/2005	20	8:00	6.8	3040	9.4	3.8
15	Eff	Grab	3/19/2005	20	8:00	6.1	3041	9.3	330
16	Eff	Grab	3/19/2005	20	8:00	6.4	3036	9.4	338
17	Eff	Grab	3/19/2005	20	8:00	7.9	3019	8.5	223
18	Eff	Grab	3/19/2005	20	8:00	7.9	3021	8.7	207
Clar	Eff	Grab	3/19/2005	20	8:00	7.7	3002	10.0	827
Baker	South	Grab	3/19/2005	20	8:00	7.6	2993	9.0	1765
Limestone	Eff	Grab	3/19/2005	20	8:00	8.8	3020	8.9	37.0
1	Eff	Grab	3/20/2005	21	15:30	7.8	2793	9.3	16.6
2	Eff	Grab	3/20/2005	21	15:30	7.9	2994	9.5	7.6
3	Eff	Grab	3/20/2005	21	15:30	7.4	665	9.4	1065
4	Eff	Grab	3/20/2005	21	15:30	7.5	682	9.3	1350
5	Eff	Grab	3/20/2005	21	15:30	7.9	2985	9.5	9.4
6	Eff	Grab	3/20/2005	21	15:30	7.9	2848	9.4	12.5
7	Eff	Grab	3/20/2005	21	15:30	8.1	3002	9.5	67.0
8	Eff	Grab	3/20/2005	21	15:30	8.0	1631	9.5	65.2
9	Eff	Grab	3/20/2005	21	15:30	7.7	685	9.5	931
10	Eff	Grab	3/20/2005	21	15:30	7.7	712	9.5	2290
11	Eff	Grab	3/20/2005	21	15:30	8.2	885	9.5	2735
12	Eff	Grab	3/20/2005	21	15:30	8.3	1711	9.6	max
13	Eff	Grab	3/20/2005	21	15:30	7.2	2349	9.4	5.2
14	Eff	Grab	3/20/2005	21	15:30	-	-	-	-
15	Eff	Grab	3/20/2005	21	15:30	6.5	3039	9.4	3.5
16	Eff	Grab	3/20/2005	21	15:30	6.1	2105	9.4	63.2
17	Eff	Grab	3/20/2005	21	15:30	7.6	1384	9.5	199
18	Eff	Grab	3/20/2005	21	15:30	7.6	2934	9.5	157
Clar	Eff	Grab	3/20/2005	21	15:30	-	-	-	182
Baker	North	Grab	3/20/2005	21	15:30	7.2	640	5.3	273
Limestone	Eff	Grab	3/20/2005	21	15:30	8.4	2954	9.6	8.0
1	Eff	Grab	3/21/2005	21	9:30	-	-	-	18.8
2	Eff	Grab	3/21/2005	21	9:30	-	-	-	12.0
3	Eff	Grab	3/21/2005	21	9:30	-	-	-	141
4	Eff	Grab	3/21/2005	21	9:30	-	-	-	105
5	Eff	Grab	3/21/2005	21	9:30	-	-	-	21.7
6	Eff	Grab	3/21/2005	21	9:30	-	-	-	15.6
7	Eff	Grab	3/21/2005	21	9:30	-	-	-	41.2
8	Eff	Grab	3/21/2005	21	9:30	-	-	-	51.6
9	Eff	Grab	3/21/2005	21	9:30	-	-	-	147
10	Eff	Grab	3/21/2005	21	9:30	-	-	-	152
11	Eff	Grab	3/21/2005	21	9:30	-	-	-	62.2
12	Eff	Grab	3/21/2005	21	9:30	-	-	-	49.0
13	Eff	Grab	3/21/2005	21	9:30	-	-	-	0.3
14	Eff	Grab	3/21/2005	21	9:30	-	-	-	0.3
15	Eff	Grab	3/21/2005	21	9:30	-	-	-	12.4
16	Eff	Grab	3/21/2005	21	9:30	-	-	-	21.9
17	Eff	Grab	3/21/2005	21	9:30	-	-	-	67.2
18	Eff	Grab	3/21/2005	21	9:30	-	-	-	106
Clar	Eff	Grab	3/21/2005	21	9:30	-	-	-	191
Baker	North	Grab	3/21/2005	21	9:30	-	-	-	250
Limestone	Eff	Grab	3/21/2005	21	9:30	-	-	-	8.7
1	Eff	Grab	3/21/2005	21	18:00	7.2	656	10.8	19.5
2	Eff	Grab	3/21/2005	21	18:00	7.7	660	10.8	13.0
3	Eff	Grab	3/21/2005	21	18:00	7.2	642	10.3	96.7
4	Eff	Grab	3/21/2005	21	18:00	-	639	10.7	75.6
5	Eff	Grab	3/21/2005	21	18:00	7.8	637	10.7	23.4
6	Eff	Grab	3/21/2005	21	18:00	7.7	643	10.7	22.0
7	Eff	Grab	3/21/2005	21	18:00	7.8	641	10.8	41.0
8	Eff	Grab	3/21/2005	21	18:00	7.8	636	10.9	52.9
9	Eff	Grab	3/21/2005	21	18:00	7.2	621	10.9	115
10	Eff	Grab	3/21/2005	21	18:00	7.2	643	10.9	109
11	Eff	Grab	3/21/2005	21	18:00	8.0	680	10.9	44.8

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
12	Eff	Grab	3/21/2005	21	18:00	8.0	690	11.0	41.4
13	Eff	Grab	3/21/2005	21	18:00	-	-	-	-
14	Eff	Grab	3/21/2005	21	18:00	-	-	-	-
15	Eff	Grab	3/21/2005	21	18:00	-	-	-	-
16	Eff	Grab	3/21/2005	21	18:00	-	-	-	-
17	Eff	Grab	3/21/2005	21	18:00	7.3	637	10.9	56.0
18	Eff	Grab	3/21/2005	21	18:00	-	-	-	-
Clar	Eff	Grab	3/21/2005	21	18:00	7.2	627	9.4	165
Baker	North	Grab	3/21/2005	21	18:00	7.3	644	7.6	237
Limestone	Eff	Grab	3/21/2005	21	18:00	8.4	662	11.0	18.6
1	Eff	Grab	3/22/2005	21	9:30	-	-	-	19.3
2	Eff	Grab	3/22/2005	21	9:30	-	-	-	15.7
3	Eff	Grab	3/22/2005	21	9:30	-	-	-	45.0
4	Eff	Grab	3/22/2005	21	9:30	-	-	-	44.1
5	Eff	Grab	3/22/2005	21	9:30	-	-	-	18.1
6	Eff	Grab	3/22/2005	21	9:30	-	-	-	13.6
7	Eff	Grab	3/22/2005	21	9:30	-	-	-	28.1
8	Eff	Grab	3/22/2005	21	9:30	-	-	-	35.4
9	Eff	Grab	3/22/2005	21	9:30	-	-	-	51.2
10	Eff	Grab	3/22/2005	21	9:30	-	-	-	50.5
11	Eff	Grab	3/22/2005	21	9:30	-	-	-	37.1
12	Eff	Grab	3/22/2005	21	9:30	-	-	-	33.1
13	Eff	Grab	3/22/2005	21	9:30	-	-	-	0.4
14	Eff	Grab	3/22/2005	21	9:30	-	-	-	0.4
15	Eff	Grab	3/22/2005	21	9:30	-	-	-	2.2
16	Eff	Grab	3/22/2005	21	9:30	-	-	-	3.5
17	Eff	Grab	3/22/2005	21	9:30	-	-	-	36.5
18	Eff	Grab	3/22/2005	21	9:30	-	-	-	33.0
Clar	Eff	Grab	3/22/2005	21	9:30	-	-	-	136
Baker	North	Grab	3/22/2005	21	9:30	-	-	-	250
Limestone	Eff	Grab	3/22/2005	21	9:30	-	-	-	15.0
1	Eff	Grab	3/22/2005	21	17:00	7.7	622	10.6	19.9
2	Eff	Grab	3/22/2005	21	17:00	7.7	628	10.6	16.3
3	Eff	Grab	3/22/2005	21	17:00	7.1	631	10.4	43.8
4	Eff	Grab	3/22/2005	21	17:00	7.1	630	10.4	43.3
5	Eff	Grab	3/22/2005	21	17:00	7.9	623	10.7	17.9
6	Eff	Grab	3/22/2005	21	17:00	7.8	619	10.7	16.7
7	Eff	Grab	3/22/2005	21	17:00	8.0	623	10.7	30.0
8	Eff	Grab	3/22/2005	21	17:00	8.0	621	10.7	33.3
9	Eff	Grab	3/22/2005	21	17:00	7.1	631	10.5	49.6
10	Eff	Grab	3/22/2005	21	17:00	7.2	636	10.5	47.5
11	Eff	Grab	3/22/2005	21	17:00	8.2	676	10.8	35.4
12	Eff	Grab	3/22/2005	21	17:00	8.0	674	10.8	39.1
13	Eff	Grab	3/22/2005	21	17:00	6.6	1119	10.7	1.6
14	Eff	Grab	3/22/2005	21	17:00	6.6	2526	10.7	0.6
15	Eff	Grab	3/22/2005	21	17:00	5.3	684	10.8	1.5
16	Eff	Grab	3/22/2005	21	17:00	5.1	681	10.7	2.8
17	Eff	Grab	3/22/2005	21	17:00	7.6	623	10.4	33.4
18	Eff	Grab	3/22/2005	21	17:00	7.7	627	10.6	31.0
Clar	Eff	Grab	3/22/2005	21	17:00	7.3	623	8.8	128
Baker	North	Grab	3/22/2005	21	17:00	7.4	640	6.1	234
Limestone	Eff	Grab	3/22/2005	21	17:00	8.6	633	10.7	16.9
1	Twelve	Grab	3/23/2005	21	14:30	-	-	-	19.5
2	Twelve	Grab	3/23/2005	21	14:30	-	-	-	18.0
3	Twelve	Grab	3/23/2005	21	14:30	-	-	-	37.0
4	Twelve	Grab	3/23/2005	21	14:30	-	-	-	36.6
5	Twelve	Grab	3/23/2005	21	14:30	-	-	-	21.9
6	Twelve	Grab	3/23/2005	21	14:30	-	-	-	22.0
7	Twelve	Grab	3/23/2005	21	14:30	-	-	-	23.5
8	Twelve	Grab	3/23/2005	21	14:30	-	-	-	30.3
9	Twelve	Grab	3/23/2005	21	14:30	-	-	-	39.3

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
10	Twelve	Grab	3/23/2005	21	14:30	-	-	-	37.9
11	Twelve	Grab	3/23/2005	21	14:30	-	-	-	35.0
12	Twelve	Grab	3/23/2005	21	14:30	-	-	-	34.9
13	Twelve	Grab	3/23/2005	21	14:30	-	-	-	10.8
14	Twelve	Grab	3/23/2005	21	14:30	-	-	-	2.3
15	Twelve	Grab	3/23/2005	21	14:30	-	-	-	17.3
16	Twelve	Grab	3/23/2005	21	14:30	-	-	-	25.2
17	Twelve	Grab	3/23/2005	21	14:30	-	-	-	28.2
18	Twelve	Grab	3/23/2005	21	14:30	-	-	-	25.7
F1	Interface	C/G	3/23/2005	21	14:30	-	-	-	46.1
F2	Interface	C/G	3/23/2005	21	14:30	-	-	-	53.8
F3	Interface	C/G	3/23/2005	21	14:30	-	-	-	139
F6	Interface	C/G	3/23/2005	21	14:30	-	-	-	46.1
1	Eff	Comp	3/23/2005	21	9:00	7.7	610	10.4	16.3
2	Eff	Comp	3/23/2005	21	9:00	7.7	617	10.3	15.4
3	Eff	Comp	3/23/2005	21	9:00	7.2	626	9.8	34.6
4	Eff	Comp	3/23/2005	21	9:00	7.2	632	10.2	33.6
5	Eff	Comp	3/23/2005	21	9:00	7.8	621	10.4	14.6
6	Eff	Comp	3/23/2005	21	9:00	7.8	622	10.5	13.8
7	Eff	Comp	3/23/2005	21	9:00	7.9	624	10.6	22.1
8	Eff	Comp	3/23/2005	21	9:00	7.8	621	10.5	28.0
9	Eff	Comp	3/23/2005	21	9:00	7.2	633	10.4	40.6
10	Eff	Comp	3/23/2005	21	9:00	7.3	632	10.5	35.8
11	Eff	Comp	3/23/2005	21	9:00	-	672	10.5	32.2
12	Eff	Comp	3/23/2005	21	9:00	8.0	673	10.6	33.2
13	Eff	Comp	3/23/2005	21	9:00	-	662	10.5	1.8
14	Eff	Comp	3/23/2005	21	9:00	-	529	10.6	0.5
15	Eff	Comp	3/23/2005	21	9:00	5.1	668	10.7	3.8
16	Eff	Comp	3/23/2005	21	9:00	-	672	10.6	5.7
17	Eff	Comp	3/23/2005	21	9:00	7.6	632	10.6	26.1
18	Eff	Comp	3/23/2005	21	9:00	7.7	627	10.6	22.5
Clar	Eff	Comp	3/23/2005	21	9:00	7.4	630	5.0	147
Baker	North	Comp	3/23/2005	21	9:00	7.4	636	6.3	267
Limestone	Eff	Comp	3/23/2005	21	9:00	-	-	-	15.9
1	Eff	Grab	3/23/2005	21	17:00	-	-	-	18.0
2	Eff	Grab	3/23/2005	21	17:00	-	-	-	14.6
3	Eff	Grab	3/23/2005	21	17:00	-	-	-	35.2
4	Eff	Grab	3/23/2005	21	17:00	-	-	-	39.0
5	Eff	Grab	3/23/2005	21	17:00	-	-	-	15.8
6	Eff	Grab	3/23/2005	21	17:00	-	-	-	-
7	Eff	Grab	3/23/2005	21	17:00	-	-	-	-
8	Eff	Grab	3/23/2005	21	17:00	-	-	-	24.6
9	Eff	Grab	3/23/2005	21	17:00	-	-	-	39.3
10	Eff	Grab	3/23/2005	21	17:00	-	-	-	34.0
11	Eff	Grab	3/23/2005	21	17:00	-	-	-	29.6
12	Eff	Grab	3/23/2005	21	17:00	-	-	-	-
13	Eff	Grab	3/23/2005	21	17:00	-	-	-	1.2
14	Eff	Grab	3/23/2005	21	17:00	-	-	-	0.3
15	Eff	Grab	3/23/2005	21	17:00	-	-	-	8.2
16	Eff	Grab	3/23/2005	21	17:00	-	-	-	12.5
17	Eff	Grab	3/23/2005	21	17:00	-	-	-	22.2
18	Eff	Grab	3/23/2005	21	17:00	-	-	-	23.2
Clar	Eff	Grab	3/23/2005	21	17:00	-	-	-	158
Baker	North	Grab	3/23/2005	21	17:00	-	-	-	246
Limestone	Eff	Grab	3/23/2005	21	17:00	-	-	-	-
1	Eff	Grab	3/24/2005	21	8:30	-	-	-	13.7
2	Eff	Grab	3/24/2005	21	8:30	-	-	-	14.7
3	Eff	Grab	3/24/2005	21	8:30	-	-	-	86.0
4	Eff	Grab	3/24/2005	21	8:30	-	-	-	25.9
5	Eff	Grab	3/24/2005	21	8:30	-	-	-	11.6

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
6	Eff	Grab	3/24/2005	21	8:30	-	-	-	12.3
7	Eff	Grab	3/24/2005	21	8:30	-	-	-	29.7
8	Eff	Grab	3/24/2005	21	8:30	-	-	-	18.7
9	Eff	Grab	3/24/2005	21	8:30	-	-	-	60.0
10	Eff	Grab	3/24/2005	21	8:30	-	-	-	91.4
11	Eff	Grab	3/24/2005	21	8:30	-	-	-	28.1
12	Eff	Grab	3/24/2005	21	8:30	-	-	-	63.7
13	Eff	Grab	3/24/2005	21	8:30	-	-	-	2.7
14	Eff	Grab	3/24/2005	21	8:30	-	-	-	0.4
15	Eff	Grab	3/24/2005	21	8:30	-	-	-	10.2
16	Eff	Grab	3/24/2005	21	8:30	-	-	-	12.9
17	Eff	Grab	3/24/2005	21	8:30	-	-	-	18.9
18	Eff	Grab	3/24/2005	21	8:30	-	-	-	16.0
Clar	Eff	Grab	3/24/2005	21	8:30	-	-	-	139
Baker	North	Grab	3/24/2005	21	8:30	-	-	-	257
Limestone	Eff	Grab	3/24/2005	21	8:30	-	-	-	10.9
1	Eff	Grab	3/24/2005	21	16:30	7.7	607	10.5	10.8
2	Eff	Grab	3/24/2005	21	16:30	7.6	611	10.6	10.0
3	Eff	Grab	3/24/2005	21	16:30	7.2	631	10.5	26.4
4	Eff	Grab	3/24/2005	21	16:30	7.1	630	10.5	25.3
5	Eff	Grab	3/24/2005	21	16:30	7.8	626	10.6	10.1
6	Eff	Grab	3/24/2005	21	16:30	7.6	628	10.6	10.7
7	Eff	Grab	3/24/2005	21	16:30	7.8	629	10.6	22.7
8	Eff	Grab	3/24/2005	21	16:30	7.8	624	10.6	16.8
9	Eff	Grab	3/24/2005	21	16:30	7.1	630	10.7	24.6
10	Eff	Grab	3/24/2005	21	16:30	7.2	630	10.7	24.4
11	Eff	Grab	3/24/2005	21	16:30	8.1	669	10.8	27.4
12	Eff	Grab	3/24/2005	21	16:30	7.9	659	10.5	41.5
13	Eff	Grab	3/24/2005	21	16:30	6.6	642	10.6	3.4
14	Eff	Grab	3/24/2005	21	16:30	6.7	636	10.7	0.2
15	Eff	Grab	3/24/2005	21	16:30	4.8	661	10.8	6.5
16	Eff	Grab	3/24/2005	21	16:30	4.7	662	10.7	12.2
17	Eff	Grab	3/24/2005	21	16:30	7.7	637	10.5	17.6
18	Eff	Grab	3/24/2005	21	16:30	7.7	635	10.6	14.6
Clar	Eff	Grab	3/24/2005	21	16:30	7.4	628	9.0	155
Baker	North	Grab	3/24/2005	21	16:30	7.6	630	8.4	281
Limestone	Eff	Grab	3/24/2005	21	16:30	8.3	634	10.8	11.0
1	Eff	Grab	3/25/2005	21	10:00	-	-	-	8.5
2	Eff	Grab	3/25/2005	21	10:00	-	-	-	7.3
3	Eff	Grab	3/25/2005	21	10:00	-	-	-	19.7
4	Eff	Grab	3/25/2005	21	10:00	-	-	-	19.6
5	Eff	Grab	3/25/2005	21	10:00	-	-	-	7.9
6	Eff	Grab	3/25/2005	21	10:00	-	-	-	9.8
7	Eff	Grab	3/25/2005	21	10:00	-	-	-	18.7
8	Eff	Grab	3/25/2005	21	10:00	-	-	-	13.4
9	Eff	Grab	3/25/2005	21	10:00	-	-	-	18.8
10	Eff	Grab	3/25/2005	21	10:00	-	-	-	17.6
11	Eff	Grab	3/25/2005	21	10:00	-	-	-	22.1
12	Eff	Grab	3/25/2005	21	10:00	-	-	-	31.3
13	Eff	Grab	3/25/2005	21	10:00	-	-	-	4.6
14	Eff	Grab	3/25/2005	21	10:00	-	-	-	0.5
15	Eff	Grab	3/25/2005	21	10:00	-	-	-	7.1
16	Eff	Grab	3/25/2005	21	10:00	-	-	-	10.5
17	Eff	Grab	3/25/2005	21	10:00	-	-	-	13.1
18	Eff	Grab	3/25/2005	21	10:00	-	-	-	12.2
Clar	Eff	Grab	3/25/2005	21	10:00	-	-	-	157
Baker	North	Grab	3/25/2005	21	10:00	-	-	-	254
Limestone	Eff	Grab	3/25/2005	21	10:00	-	-	-	10.0
1	Eff	Grab	3/25/2005	21	16:00	7.8	615	10.1	7.6
2	Eff	Grab	3/25/2005	21	16:00	7.8	610	10.0	6.8
3	Eff	Grab	3/25/2005	21	16:00	7.2	640	10.0	22.0

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
4	Eff	Grab	3/25/2005	21	16:00	7.2	637	10.1	19.9
5	Eff	Grab	3/25/2005	21	16:00	7.8	627	10.1	7.6
6	Eff	Grab	3/25/2005	21	16:00	7.8	630	10.1	8.6
7	Eff	Grab	3/25/2005	21	16:00	7.9	630	10.1	17.5
8	Eff	Grab	3/25/2005	21	16:00	8.0	629	10.1	12.9
9	Eff	Grab	3/25/2005	21	16:00	7.2	632	10.2	19.4
10	Eff	Grab	3/25/2005	21	16:00	7.2	632	10.3	19.5
11	Eff	Grab	3/25/2005	21	16:00	8.1	668	10.3	24.9
12	Eff	Grab	3/25/2005	21	16:00	8.2	661	10.3	32.8
13	Eff	Grab	3/25/2005	21	16:00	6.8	647	10.1	4.5
14	Eff	Grab	3/25/2005	21	16:00	6.8	644	10.1	0.3
15	Eff	Grab	3/25/2005	21	16:00	4.9	661	10.2	7.2
16	Eff	Grab	3/25/2005	21	16:00	4.7	661	10.2	9.1
17	Eff	Grab	3/25/2005	21	16:00	7.5	579	10.1	2.5
18	Eff	Grab	3/25/2005	21	16:00	7.7	639	10.0	12.1
Clar	Eff	Grab	3/25/2005	21	16:00	7.6	631	9.3	145
Baker	North	Grab	3/25/2005	21	16:00	7.7	656	9.5	261
Limestone	Eff	Grab	3/25/2005	21	16:00	8.6	639	10.3	9.2
1	Eff	Grab	3/26/2005	21	9:00	7.9	616	9.4	6.2
2	Eff	Grab	3/26/2005	21	9:00	8.0	608	9.4	5.5
3	Eff	Grab	3/26/2005	21	9:00	7.1	629	9.1	18.8
4	Eff	Grab	3/26/2005	21	9:00	7.2	633	9.3	16.9
5	Eff	Grab	3/26/2005	21	9:00	8.0	620	9.4	6.0
6	Eff	Grab	3/26/2005	21	9:00	8.0	624	9.4	7.5
7	Eff	Grab	3/26/2005	21	9:00	8.1	623	9.4	13.7
8	Eff	Grab	3/26/2005	21	9:00	8.1	621	9.4	11.7
9	Eff	Grab	3/26/2005	21	9:00	7.2	631	9.4	17.3
10	Eff	Grab	3/26/2005	21	9:00	7.2	630	9.4	16.3
11	Eff	Grab	3/26/2005	21	9:00	8.2	664	9.5	21.5
12	Eff	Grab	3/26/2005	21	9:00	8.3	657	9.5	26.5
13	Eff	Grab	3/26/2005	21	9:00	6.8	644	9.5	4.3
14	Eff	Grab	3/26/2005	21	9:00	6.9	646	9.5	0.4
15	Eff	Grab	3/26/2005	21	9:00	5.0	655	9.6	5.4
16	Eff	Grab	3/26/2005	21	9:00	4.7	656	9.5	6.9
17	Eff	Grab	3/26/2005	21	9:00	7.7	636	9.2	11.1
18	Eff	Grab	3/26/2005	21	9:00	7.8	634	9.4	11.9
Clar	Eff	Grab	3/26/2005	21	9:00	7.6	637	8.3	176
Baker	North	Grab	3/26/2005	21	9:00	7.7	631	9.0	270
Limestone	Eff	Grab	3/26/2005	21	9:00	8.7	632	9.5	8.0
1	Eff	Grab	4/23/2005	22	16:30	-	-	-	3.21
2	Eff	Grab	4/23/2005	22	16:30	-	-	-	2.42
3	Eff	Grab	4/23/2005	22	16:30	-	-	-	1.38
4	Eff	Grab	4/23/2005	22	16:30	-	-	-	1.59
5	Eff	Grab	4/23/2005	22	16:30	-	-	-	2.19
6	Eff	Grab	4/23/2005	22	16:30	-	-	-	0.774
7	Eff	Grab	4/23/2005	22	16:30	-	-	-	5.42
8	Eff	Grab	4/23/2005	22	16:30	-	-	-	8.24
9	Eff	Grab	4/23/2005	22	16:30	-	-	-	1.46
10	Eff	Grab	4/23/2005	22	16:30	-	-	-	1.53
11	Eff	Grab	4/23/2005	22	16:30	-	-	-	2.34
12	Eff	Grab	4/23/2005	22	16:30	-	-	-	15.0
13	Eff	Grab	4/23/2005	22	16:30	-	-	-	0.420
14	Eff	Grab	4/23/2005	22	16:30	-	-	-	0.322
15	Eff	Grab	4/23/2005	22	16:30	-	-	-	0.385
16	Eff	Grab	4/23/2005	22	16:30	-	-	-	1.40
17	Eff	Grab	4/23/2005	22	16:30	-	-	-	3.44
18	Eff	Grab	4/23/2005	22	16:30	-	-	-	3.23
Clar	Eff	Grab	4/23/2005	22	16:30	-	-	-	245
Baker	North	Grab	4/23/2005	22	16:30	-	-	-	400
Limestone	Eff	Grab	4/23/2005	22	16:30	-	-	-	2.13
1	Eff	Grab	4/24/2005	22	9:30	-	-	-	1.50

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
2	Eff	Grab	4/24/2005	22	9:30	-	-	-	0.796
3	Eff	Grab	4/24/2005	22	9:30	-	-	-	40.8
4	Eff	Grab	4/24/2005	22	9:30	-	-	-	36.8
5	Eff	Grab	4/24/2005	22	9:30	-	-	-	0.895
6	Eff	Grab	4/24/2005	22	9:30	-	-	-	0.641
7	Eff	Grab	4/24/2005	22	9:30	-	-	-	9.64
8	Eff	Grab	4/24/2005	22	9:30	-	-	-	9.46
9	Eff	Grab	4/24/2005	22	9:30	-	-	-	36.4
10	Eff	Grab	4/24/2005	22	9:30	-	-	-	30.6
11	Eff	Grab	4/24/2005	22	9:30	-	-	-	35.4
12	Eff	Grab	4/24/2005	22	9:30	-	-	-	55.4
13	Eff	Grab	4/24/2005	22	9:30	-	-	-	0.691
14	Eff	Grab	4/24/2005	22	9:30	-	-	-	1.55
15	Eff	Grab	4/24/2005	22	9:30	-	-	-	2.24
16	Eff	Grab	4/24/2005	22	9:30	-	-	-	7.16
17	Eff	Grab	4/24/2005	22	9:30	-	-	-	10.4
18	Eff	Grab	4/24/2005	22	9:30	-	-	-	0.574
Clar	Eff	Grab	4/24/2005	22	9:30	-	-	-	265
Baker	North	Grab	4/24/2005	22	9:30	-	-	-	419
Limestone	Eff	Grab	4/24/2005	22	9:30	-	-	-	9.22
1	Eff	Grab	4/24/2005	22	18:00	8.0	>4000	11.3	0.838
2	Eff	Grab	4/24/2005	22	18:00	8.1	>4000	11.4	0.624
3	Eff	Grab	4/24/2005	22	18:00	7.1	>4000	10.2	45.6
4	Eff	Grab	4/24/2005	22	18:00	7.0	>4000	10.4	42.2
5	Eff	Grab	4/24/2005	22	18:00	8.1	>4000	11.4	6.19
6	Eff	Grab	4/24/2005	22	18:00	8.1	>4000	11.4	0.570
7	Eff	Grab	4/24/2005	22	18:00	8.2	>4000	11.4	7.40
8	Eff	Grab	4/24/2005	22	18:00	8.2	>4000	11.5	7.99
9	Eff	Grab	4/24/2005	22	18:00	7.2	>4000	10.9	39.8
10	Eff	Grab	4/24/2005	22	18:00	7.3	>4000	11.4	38.1
11	Eff	Grab	4/24/2005	22	18:00	8.3	>4000	11.6	39.3
12	Eff	Grab	4/24/2005	22	18:00	8.3	>4000	11.4	56.3
13	Eff	Grab	4/24/2005	22	18:00	7.8	>4000	11.2	0.416
14	Eff	Grab	4/24/2005	22	18:00	7.7	>4000	11.2	2.22
15	Eff	Grab	4/24/2005	22	18:00	5.8	>4000	11.2	3.10
16	Eff	Grab	4/24/2005	22	18:00	5.7	>4000	11.3	7.58
17	Eff	Grab	4/24/2005	22	18:00	7.5	>4000	11.2	12.4
18	Eff	Grab	4/24/2005	22	18:00	7.6	>4000	10.5	0.514
Clar	Eff	Grab	4/24/2005	22	18:00	7.2	>4000	9.7	291
Baker	North	Grab	4/24/2005	22	18:00	7.5	>4000	7.4	320
Limestone	Eff	Grab	4/24/2005	22	18:00	8.5	>4000	11.5	1.19
1	Eff	Grab	4/25/2005	22	8:30	-	-	-	0.367
2	Eff	Grab	4/25/2005	22	8:30	-	-	-	0.330
3	Eff	Grab	4/25/2005	22	8:30	-	-	-	40.4
4	Eff	Grab	4/25/2005	22	8:30	-	-	-	39.3
5	Eff	Grab	4/25/2005	22	8:30	-	-	-	0.544
6	Eff	Grab	4/25/2005	22	8:30	-	-	-	0.433
7	Eff	Grab	4/25/2005	22	8:30	-	-	-	7.84
8	Eff	Grab	4/25/2005	22	8:30	-	-	-	8.05
9	Eff	Grab	4/25/2005	22	8:30	-	-	-	31.8
10	Eff	Grab	4/25/2005	22	8:30	-	-	-	31.1
11	Eff	Grab	4/25/2005	22	8:30	-	-	-	40.0
12	Eff	Grab	4/25/2005	22	8:30	-	-	-	48.1
13	Eff	Grab	4/25/2005	22	8:30	-	-	-	0.304
14	Eff	Grab	4/25/2005	22	8:30	-	-	-	0.337
15	Eff	Grab	4/25/2005	22	8:30	-	-	-	3.46
16	Eff	Grab	4/25/2005	22	8:30	-	-	-	5.64
17	Eff	Grab	4/25/2005	22	8:30	-	-	-	15.4
18	Eff	Grab	4/25/2005	22	8:30	-	-	-	9.22
Clar	Eff	Grab	4/25/2005	22	8:30	-	-	-	253
Baker	North	Grab	4/25/2005	22	8:30	-	-	-	388
Limestone	Eff	Grab	4/25/2005	22	8:30	-	-	-	0.498

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
1	Eff	Grab	4/25/2005	22	17:10	8.0	3640	11.7	0.348
2	Eff	Grab	4/25/2005	22	17:10	8.0	3632	11.6	0.319
3	Eff	Grab	4/25/2005	22	17:10	7.3	3634	11.5	46.4
4	Eff	Grab	4/25/2005	22	17:10	7.2	3629	11.7	43.9
5	Eff	Grab	4/25/2005	22	17:10	8.0	3665	11.8	0.372
6	Eff	Grab	4/25/2005	22	17:10	8.1	3654	11.8	0.337
7	Eff	Grab	4/25/2005	22	17:10	8.2	3654	11.8	8.56
8	Eff	Grab	4/25/2005	22	17:10	8.2	3658	11.8	8.48
9	Eff	Grab	4/25/2005	22	17:10	7.3	3616	11.8	37.9
10	Eff	Grab	4/25/2005	22	17:10	7.4	3617	11.8	36.2
11	Eff	Grab	4/25/2005	22	17:10	8.5	3640	11.8	44.0
12	Eff	Grab	4/25/2005	22	17:10	8.4	3651	11.7	52.7
13	Eff	Grab	4/25/2005	22	17:10	7.2	3641	11.5	0.306
14	Eff	Grab	4/25/2005	22	17:10	7.4	3220	11.3	0.315
15	Eff	Grab	4/25/2005	22	17:10	5.7	3631	11.4	5.25
16	Eff	Grab	4/25/2005	22	17:10	5.5	3641	11.6	3.96
17	Eff	Grab	4/25/2005	22	17:10	7.5	3645	11.5	16.0
18	Eff	Grab	4/25/2005	22	17:10	7.7	3657	11.3	11.4
Clar	Eff	Grab	4/25/2005	22	17:10	7.4	3620	11.6	269
Baker	North	Grab	4/25/2005	22	17:10	7.4	3614	11.5	445
Limestone	Eff	Grab	4/25/2005	22	17:10	8.6	3664	11.9	0.631
1	Eff	Comp	4/26/2005	22	9:00	8.0	3661	12.6	0.892
2	Eff	Comp	4/26/2005	22	9:00	8.1	3651	12.6	0.663
3	Eff	Comp	4/26/2005	22	9:00	7.4	3640	12.6	42.1
4	Eff	Comp	4/26/2005	22	9:00	7.4	3642	12.6	40.3
5	Eff	Comp	4/26/2005	22	9:00	8.1	3668	12.6	1.21
6	Eff	Comp	4/26/2005	22	9:00	8.1	3668	12.6	0.742
7	Eff	Comp	4/26/2005	22	9:00	8.2	3663	12.6	8.32
8	Eff	Comp	4/26/2005	22	9:00	8.2	3672	12.6	7.65
9	Eff	Comp	4/26/2005	22	9:00	7.4	3648	12.6	35.2
10	Eff	Comp	4/26/2005	22	9:00	7.5	3648	12.6	34.3
11	Eff	Comp	4/26/2005	22	9:00	8.3	3656	12.6	40.5
12	Eff	Comp	4/26/2005	22	9:00	8.3	3664	12.6	49.9
13	Eff	Comp	4/26/2005	22	9:00	7.5	3672	12.6	0.534
14	Eff	Comp	4/26/2005	22	9:00	7.5	3524	12.6	0.519
15	Eff	Comp	4/26/2005	22	9:00	6.3	3654	12.6	4.18
16	Eff	Comp	4/26/2005	22	9:00	6.2	3646	12.6	2.91
17	Eff	Comp	4/26/2005	22	9:00	7.6	3642	12.6	19.1
18	Eff	Comp	4/26/2005	22	9:00	7.7	3658	12.6	11.8
Clar	Eff	Comp	4/26/2005	22	9:00	7.5	3624	11.6	263
Baker	North	Comp	4/26/2005	22	9:00	7.5	3616	13.3	385
Limestone	Eff	Comp	4/26/2005	22	9:00	8.4	3642	12.6	0.865
1	Twelve	Grab	4/26/2005	22	15:00	-	-	-	28.1
2	Twelve	Grab	4/26/2005	22	15:00	-	-	-	31.0
3	Twelve	Grab	4/26/2005	22	15:00	-	-	-	88.9
4	Twelve	Grab	4/26/2005	22	15:00	-	-	-	66.3
5	Twelve	Grab	4/26/2005	22	15:00	-	-	-	43.1
6	Twelve	Grab	4/26/2005	22	15:00	-	-	-	40.2
7	Twelve	Grab	4/26/2005	22	15:00	-	-	-	58.0
8	Twelve	Grab	4/26/2005	22	15:00	-	-	-	55.2
9	Twelve	Grab	4/26/2005	22	15:00	-	-	-	134
10	Twelve	Grab	4/26/2005	22	15:00	-	-	-	94.2
11	Twelve	Grab	4/26/2005	22	15:00	-	-	-	118
12	Twelve	Grab	4/26/2005	22	15:00	-	-	-	64.6
13	Twelve	Grab	4/26/2005	22	15:00	-	-	-	4.12
14	Twelve	Grab	4/26/2005	22	15:00	-	-	-	19.3
15	Twelve	Grab	4/26/2005	22	15:00	-	-	-	32.6
16	Twelve	Grab	4/26/2005	22	15:00	-	-	-	258
17	Twelve	Grab	4/26/2005	22	15:00	-	-	-	40.0
18	Twelve	Grab	4/26/2005	22	15:00	-	-	-	60.2
F1	Interface	C/G	4/26/2005	22	15:00	-	-	-	1726

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
F2	Interface	C/G	4/26/2005	22	15:00	-	-	-	487
F3	Interface	C/G	4/26/2005	22	15:00	-	-	-	1523
1	Eff	Grab	4/26/2005	22	16:30	-	-	-	0.312
2	Eff	Grab	4/26/2005	22	16:30	-	-	-	0.355
3	Eff	Grab	4/26/2005	22	16:30	-	-	-	41.1
4	Eff	Grab	4/26/2005	22	16:30	-	-	-	43.2
5	Eff	Grab	4/26/2005	22	16:30	-	-	-	0.518
6	Eff	Grab	4/26/2005	22	16:30	-	-	-	0.392
7	Eff	Grab	4/26/2005	22	16:30	-	-	-	16.9
8	Eff	Grab	4/26/2005	22	16:30	-	-	-	12.2
9	Eff	Grab	4/26/2005	22	16:30	-	-	-	26.2
10	Eff	Grab	4/26/2005	22	16:30	-	-	-	35.4
11	Eff	Grab	4/26/2005	22	16:30	-	-	-	54.8
12	Eff	Grab	4/26/2005	22	16:30	-	-	-	56.6
13	Eff	Grab	4/26/2005	22	16:30	-	-	-	-
14	Eff	Grab	4/26/2005	22	16:30	-	-	-	-
15	Eff	Grab	4/26/2005	22	16:30	-	-	-	7.50
16	Eff	Grab	4/26/2005	22	16:30	-	-	-	4.54
17	Eff	Grab	4/26/2005	22	16:30	-	-	-	27.3
18	Eff	Grab	4/26/2005	22	16:30	-	-	-	20.0
Clar	Eff	Grab	4/26/2005	22	16:30	-	-	-	272
Baker	North	Grab	4/26/2005	22	16:30	-	-	-	383
Limestone	Eff	Grab	4/26/2005	22	16:30	-	-	-	0.407
1	Eff	Grab	4/27/2005	22	8:30	-	-	-	0.455
2	Eff	Grab	4/27/2005	22	8:30	-	-	-	0.356
3	Eff	Grab	4/27/2005	22	8:30	-	-	-	35.4
4	Eff	Grab	4/27/2005	22	8:30	-	-	-	37.1
5	Eff	Grab	4/27/2005	22	8:30	-	-	-	1.66
6	Eff	Grab	4/27/2005	22	8:30	-	-	-	0.532
7	Eff	Grab	4/27/2005	22	8:30	-	-	-	16.4
8	Eff	Grab	4/27/2005	22	8:30	-	-	-	11.4
9	Eff	Grab	4/27/2005	22	8:30	-	-	-	35.5
10	Eff	Grab	4/27/2005	22	8:30	-	-	-	32.8
11	Eff	Grab	4/27/2005	22	8:30	-	-	-	49.6
12	Eff	Grab	4/27/2005	22	8:30	-	-	-	43.5
13	Eff	Grab	4/27/2005	22	8:30	-	-	-	0.659
14	Eff	Grab	4/27/2005	22	8:30	-	-	-	-
15	Eff	Grab	4/27/2005	22	8:30	-	-	-	-
16	Eff	Grab	4/27/2005	22	8:30	-	-	-	1.95
17	Eff	Grab	4/27/2005	22	8:30	-	-	-	27.6
18	Eff	Grab	4/27/2005	22	8:30	-	-	-	21.4
Clar	Eff	Grab	4/27/2005	22	8:30	-	-	-	284
Baker	North	Grab	4/27/2005	22	8:30	-	-	-	401
Limestone	Eff	Grab	4/27/2005	22	8:30	-	-	-	0.487
1	Eff	Grab	4/27/2005	22	16:30	7.6	3648	12.4	0.697
2	Eff	Grab	4/27/2005	22	16:30	7.9	3647	12.4	0.420
3	Eff	Grab	4/27/2005	22	16:30	7.2	3620	12.4	35.9
4	Eff	Grab	4/27/2005	22	16:30	7.2	3615	12.4	37.4
5	Eff	Grab	4/27/2005	22	16:30	8.0	3640	12.4	20.5
6	Eff	Grab	4/27/2005	22	16:30	8.0	3637	12.4	0.833
7	Eff	Grab	4/27/2005	22	16:30	8.1	3644	12.4	17.0
8	Eff	Grab	4/27/2005	22	16:30	8.1	3643	12.4	12.1
9	Eff	Grab	4/27/2005	22	16:30	7.3	3614	12.4	41.3
10	Eff	Grab	4/27/2005	22	16:30	7.3	3610	12.4	34.1
11	Eff	Grab	4/27/2005	22	16:30	8.4	3629	12.4	51.0
12	Eff	Grab	4/27/2005	22	16:30	8.4	3634	12.4	42.0
13	Eff	Grab	4/27/2005	22	16:30	7.3	>4000	12.4	0.533
14	Eff	Grab	4/27/2005	22	16:30	7.6	>4000	12.4	4.44
15	Eff	Grab	4/27/2005	22	16:30	5.8	3686	12.4	12.0
16	Eff	Grab	4/27/2005	22	16:30	5.5	3634	12.4	4.86
17	Eff	Grab	4/27/2005	22	16:30	7.4	3617	12.4	25.9

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
18	Eff	Grab	4/27/2005	22	16:30	7.4	3624	12.4	22.4
Clar	Eff	Grab	4/27/2005	22	16:30	7.4	3584	11.4	303
Baker	North	Grab	4/27/2005	22	16:30	7.4	3548	11.6	401
Limestone	Eff	Grab	4/27/2005	22	16:30	8.4	3637	12.4	0.489
1	Eff	Grab	4/28/2005	22	8:30	-	-	-	2.05
2	Eff	Grab	4/28/2005	22	8:30	-	-	-	0.591
3	Eff	Grab	4/28/2005	22	8:30	-	-	-	29.1
4	Eff	Grab	4/28/2005	22	8:30	-	-	-	35.3
5	Eff	Grab	4/28/2005	22	8:30	-	-	-	7.74
6	Eff	Grab	4/28/2005	22	8:30	-	-	-	0.663
7	Eff	Grab	4/28/2005	22	8:30	-	-	-	18.4
8	Eff	Grab	4/28/2005	22	8:30	-	-	-	12.6
9	Eff	Grab	4/28/2005	22	8:30	-	-	-	41.1
10	Eff	Grab	4/28/2005	22	8:30	-	-	-	33.7
11	Eff	Grab	4/28/2005	22	8:30	-	-	-	52.1
12	Eff	Grab	4/28/2005	22	8:30	-	-	-	43.9
13	Eff	Grab	4/28/2005	22	8:30	-	-	-	1.33
14	Eff	Grab	4/28/2005	22	8:30	-	-	-	1.12
15	Eff	Grab	4/28/2005	22	8:30	-	-	-	6.76
16	Eff	Grab	4/28/2005	22	8:30	-	-	-	13.2
17	Eff	Grab	4/28/2005	22	8:30	-	-	-	26.5
18	Eff	Grab	4/28/2005	22	8:30	-	-	-	23.4
Clar	Eff	Grab	4/28/2005	22	8:30	-	-	-	266
Baker	North	Grab	4/28/2005	22	8:30	-	-	-	401
Limestone	Eff	Grab	4/28/2005	22	8:30	-	-	-	0.546
1	Eff	Grab	4/28/2005	22	16:30	7.8	3633	11.3	2.73
2	Eff	Grab	4/28/2005	22	16:30	7.9	3637	11.6	0.486
3	Eff	Grab	4/28/2005	22	16:30	7.3	3582	11.7	24.2
4	Eff	Grab	4/28/2005	22	16:30	7.3	3609	11.6	38.7
5	Eff	Grab	4/28/2005	22	16:30	8.0	3631	11.6	3.83
6	Eff	Grab	4/28/2005	22	16:30	8.0	3625	11.6	0.645
7	Eff	Grab	4/28/2005	22	16:30	8.0	3640	11.5	19.7
8	Eff	Grab	4/28/2005	22	16:30	8.1	3635	11.5	14.9
9	Eff	Grab	4/28/2005	22	16:30	7.3	3615	11.6	44.8
10	Eff	Grab	4/28/2005	22	16:30	7.3	3614	11.5	40.4
11	Eff	Grab	4/28/2005	22	16:30	8.3	3627	11.5	53.9
12	Eff	Grab	4/28/2005	22	16:30	8.3	3640	11.4	46.4
13	Eff	Grab	4/28/2005	22	16:30	-	-	-	-
14	Eff	Grab	4/28/2005	22	16:30	-	-	-	-
15	Eff	Grab	4/28/2005	22	16:30	5.9	3620	11.5	6.59
16	Eff	Grab	4/28/2005	22	16:30	5.8	3633	11.4	20.4
17	Eff	Grab	4/28/2005	22	16:30	7.4	3620	11.4	30.9
18	Eff	Grab	4/28/2005	22	16:30	7.4	3618	11.4	24.6
Clar	Eff	Grab	4/28/2005	22	16:30	7.5	3733	12.6	264
Baker	North	Grab	4/28/2005	22	16:30	7.5	3600	15.7	400
Limestone	Eff	Grab	4/28/2005	22	16:30	8.4	3647	11.4	0.743
1	Eff	Grab	4/29/2005	22	8:35	-	-	-	3.46
2	Eff	Grab	4/29/2005	22	8:35	-	-	-	0.936
3	Eff	Grab	4/29/2005	22	8:35	-	-	-	48.7
4	Eff	Grab	4/29/2005	22	8:35	-	-	-	44.6
5	Eff	Grab	4/29/2005	22	8:35	-	-	-	5.04
6	Eff	Grab	4/29/2005	22	8:35	-	-	-	0.889
7	Eff	Grab	4/29/2005	22	8:35	-	-	-	24.1
8	Eff	Grab	4/29/2005	22	8:35	-	-	-	25.3
9	Eff	Grab	4/29/2005	22	8:35	-	-	-	44.1
10	Eff	Grab	4/29/2005	22	8:35	-	-	-	37.5
11	Eff	Grab	4/29/2005	22	8:35	-	-	-	50.4
12	Eff	Grab	4/29/2005	22	8:35	-	-	-	53.4
13	Eff	Grab	4/29/2005	22	8:35	-	-	-	-
14	Eff	Grab	4/29/2005	22	8:35	-	-	-	-
15	Eff	Grab	4/29/2005	22	8:35	-	-	-	15.6

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
16	Eff	Grab	4/29/2005	22	8:35	-	-	-	25.1
17	Eff	Grab	4/29/2005	22	8:35	-	-	-	24.0
18	Eff	Grab	4/29/2005	22	8:35	-	-	-	25.2
Clar	Eff	Grab	4/29/2005	22	8:35	-	-	-	298
Baker	North	Grab	4/29/2005	22	8:35	-	-	-	420
Limestone	Eff	Grab	4/29/2005	22	8:35	-	-	-	1.66
1	Eff	Grab	4/29/2005	22	16:30	7.7	3693	13.0	3.41
2	Eff	Grab	4/29/2005	22	16:30	8.0	3693	13.0	0.834
3	Eff	Grab	4/29/2005	22	16:30	7.4	3619	13.0	52.4
4	Eff	Grab	4/29/2005	22	16:30	7.4	3557	13.0	42.6
5	Eff	Grab	4/29/2005	22	16:30	7.9	3630	13.0	4.59
6	Eff	Grab	4/29/2005	22	16:30	7.9	3632	13.0	1.53
7	Eff	Grab	4/29/2005	22	16:30	8.1	3634	13.0	19.8
8	Eff	Grab	4/29/2005	22	16:30	8.1	3638	13.0	15.4
9	Eff	Grab	4/29/2005	22	16:30	7.4	3598	13.0	52.8
10	Eff	Grab	4/29/2005	22	16:30	7.4	3612	13.0	44.3
11	Eff	Grab	4/29/2005	22	16:30	8.4	3626	13.0	53.6
12	Eff	Grab	4/29/2005	22	16:30	8.4	3634	13.0	69.4
13	Eff	Grab	4/29/2005	22	16:30	-	-	-	-
14	Eff	Grab	4/29/2005	22	16:30	-	-	-	-
15	Eff	Grab	4/29/2005	22	16:30	5.8	3683	13.0	21.1
16	Eff	Grab	4/29/2005	22	16:30	5.7	3637	13.0	30.3
17	Eff	Grab	4/29/2005	22	16:30	7.4	3614	13.0	23.7
18	Eff	Grab	4/29/2005	22	16:30	7.4	3614	13.0	27.0
Clar	Eff	Grab	4/29/2005	22	16:30	7.6	3655	12.4	280
Baker	North	Grab	4/29/2005	22	16:30	7.5	3605	13.6	459
Limestone	Eff	Grab	4/29/2005	22	16:30	8.6	3654	13.0	2.26
1	Eff	Grab	4/30/2005	22	9:00	-	-	-	3.61
2	Eff	Grab	4/30/2005	22	9:00	-	-	-	1.52
3	Eff	Grab	4/30/2005	22	9:00	-	-	-	45.7
4	Eff	Grab	4/30/2005	22	9:00	-	-	-	32.4
5	Eff	Grab	4/30/2005	22	9:00	-	-	-	5.02
6	Eff	Grab	4/30/2005	22	9:00	-	-	-	2.78
7	Eff	Grab	4/30/2005	22	9:00	-	-	-	18.1
8	Eff	Grab	4/30/2005	22	9:00	-	-	-	12.0
9	Eff	Grab	4/30/2005	22	9:00	-	-	-	45.8
10	Eff	Grab	4/30/2005	22	9:00	-	-	-	37.5
11	Eff	Grab	4/30/2005	22	9:00	-	-	-	49.1
12	Eff	Grab	4/30/2005	22	9:00	-	-	-	54.5
13	Eff	Grab	4/30/2005	22	9:00	-	-	-	-
14	Eff	Grab	4/30/2005	22	9:00	-	-	-	-
15	Eff	Grab	4/30/2005	22	9:00	-	-	-	26.0
16	Eff	Grab	4/30/2005	22	9:00	-	-	-	33.6
17	Eff	Grab	4/30/2005	22	9:00	-	-	-	22.0
18	Eff	Grab	4/30/2005	22	9:00	-	-	-	25.5
Clar	Eff	Grab	4/30/2005	22	9:00	-	-	-	262
Baker	North	Grab	4/30/2005	22	9:00	-	-	-	278
Limestone	Eff	Grab	4/30/2005	22	9:00	-	-	-	1.89
1	Eff	Grab	4/30/2005	23	16:15	7.6	2956	11.6	7.41
2	Eff	Grab	4/30/2005	23	16:15	7.8	3360	11.8	2.31
3	Eff	Grab	4/30/2005	23	16:15	7.8	709	11.6	1292
4	Eff	Grab	4/30/2005	23	16:15	7.7	677	11.8	432
5	Eff	Grab	4/30/2005	23	16:15	7.9	2921	12.0	30.2
6	Eff	Grab	4/30/2005	23	16:15	7.4	2604	11.9	7.20
7	Eff	Grab	4/30/2005	23	16:15	7.7	2748	11.9	110
8	Eff	Grab	4/30/2005	23	16:15	7.6	1253	11.9	6.61
9	Eff	Grab	4/30/2005	23	16:15	7.2	3240	12.0	73.6
10	Eff	Grab	4/30/2005	23	16:15	7.8	877	12.1	3383
11	Eff	Grab	4/30/2005	23	16:15	9.4	779	12.3	1084
12	Eff	Grab	4/30/2005	23	16:15	9.5	797	12.0	906
13	Eff	Grab	4/30/2005	23	16:15	8.2	879	11.9	11.9

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
14	Eff	Grab	4/30/2005	23	16:15	7.9	772	11.7	8.83
15	Eff	Grab	4/30/2005	23	16:15	5.9	2324	11.8	90.9
16	Eff	Grab	4/30/2005	23	16:15	6.0	1965	11.8	211
17	Eff	Grab	4/30/2005	23	16:15	7.3	2173	11.1	311
18	Eff	Grab	4/30/2005	23	16:15	7.4	1956	11.5	312
Clar	Eff	Grab	4/30/2005	23	16:15	7.4	582	11.3	211
Baker	North	Grab	4/30/2005	23	16:15	7.4	556	10.6	285
Limestone	Eff	Grab	4/30/2005	23	16:15	8.8	3476	12.1	5.21
1	Eff	Grab	5/1/2005	23	8:15	-	-	-	32.4
2	Eff	Grab	5/1/2005	23	8:15	-	-	-	5.25
3	Eff	Grab	5/1/2005	23	8:15	-	-	-	126
4	Eff	Grab	5/1/2005	23	8:15	-	-	-	75.8
5	Eff	Grab	5/1/2005	23	8:15	-	-	-	65.0
6	Eff	Grab	5/1/2005	23	8:15	-	-	-	22.8
7	Eff	Grab	5/1/2005	23	8:15	-	-	-	74.0
8	Eff	Grab	5/1/2005	23	8:15	-	-	-	55.0
9	Eff	Grab	5/1/2005	23	8:15	-	-	-	163
10	Eff	Grab	5/1/2005	23	8:15	-	-	-	180
11	Eff	Grab	5/1/2005	23	8:15	-	-	-	67.2
12	Eff	Grab	5/1/2005	23	8:15	-	-	-	63.1
13	Eff	Grab	5/1/2005	23	8:15	-	-	-	43.6
14	Eff	Grab	5/1/2005	23	8:15	-	-	-	37.4
15	Eff	Grab	5/1/2005	23	8:15	-	-	-	57.0
16	Eff	Grab	5/1/2005	23	8:15	-	-	-	72.5
17	Eff	Grab	5/1/2005	23	8:15	-	-	-	127
18	Eff	Grab	5/1/2005	23	8:15	-	-	-	130
Clar	Eff	Grab	5/1/2005	23	8:15	-	-	-	118
Baker	North	Grab	5/1/2005	23	8:15	-	-	-	290
Limestone	Eff	Grab	5/1/2005	23	8:15	-	-	-	12.2
1	Eff	Grab	5/1/2005	23	16:30	7.4	632	12.2	45.4
2	Eff	Grab	5/1/2005	23	16:30	7.5	676	12.2	18.1
3	Eff	Grab	5/1/2005	23	16:30	7.5	623	12.1	69.9
4	Eff	Grab	5/1/2005	23	16:30	7.4	632	12.4	71.3
5	Eff	Grab	5/1/2005	23	16:30	7.9	602	12.2	77.2
6	Eff	Grab	5/1/2005	23	16:30	7.9	614	12.4	37.1
7	Eff	Grab	5/1/2005	23	16:30	8.0	607	12.4	105
8	Eff	Grab	5/1/2005	23	16:30	7.9	620	12.3	71.2
9	Eff	Grab	5/1/2005	23	16:30	7.4	626	12.4	112
10	Eff	Grab	5/1/2005	23	16:30	7.4	630	12.5	110
11	Eff	Grab	5/1/2005	23	16:30	8.1	660	12.5	58.5
12	Eff	Grab	5/1/2005	23	16:30	8.2	657	12.2	61.8
13	Eff	Grab	5/1/2005	23	16:30	7.2	636	12.2	39.9
14	Eff	Grab	5/1/2005	23	16:30	7.2	658	12.3	38.1
15	Eff	Grab	5/1/2005	23	16:30	4.9	658	12.4	49.2
16	Eff	Grab	5/1/2005	23	16:30	5.1	656	12.4	63.6
17	Eff	Grab	5/1/2005	23	16:30	7.5	587	12.3	77.6
18	Eff	Grab	5/1/2005	23	16:30	7.5	586	12.2	79.3
Clar	Eff	Grab	5/1/2005	23	16:30	7.5	622	11.8	196
Baker	North	Grab	5/1/2005	23	16:30	7.5	633	11.5	237
Limestone	Eff	Grab	5/1/2005	23	16:30	8.4	634	12.3	31.8
1	Eff	Grab	5/2/2005	23	8:15	-	-	-	34.3
2	Eff	Grab	5/2/2005	23	8:15	-	-	-	27.0
3	Eff	Grab	5/2/2005	23	8:15	-	-	-	56.5
4	Eff	Grab	5/2/2005	23	8:15	-	-	-	61.8
5	Eff	Grab	5/2/2005	23	8:15	-	-	-	49.4
6	Eff	Grab	5/2/2005	23	8:15	-	-	-	32.8
7	Eff	Grab	5/2/2005	23	8:15	-	-	-	80
8	Eff	Grab	5/2/2005	23	8:15	-	-	-	70.3
9	Eff	Grab	5/2/2005	23	8:15	-	-	-	74.5
10	Eff	Grab	5/2/2005	23	8:15	-	-	-	74.3
11	Eff	Grab	5/2/2005	23	8:15	-	-	-	56.2

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
12	Eff	Grab	5/2/2005	23	8:15	-	-	-	55.0
13	Eff	Grab	5/2/2005	23	8:15	-	-	-	40.1
14	Eff	Grab	5/2/2005	23	8:15	-	-	-	42.8
15	Eff	Grab	5/2/2005	23	8:15	-	-	-	40.8
16	Eff	Grab	5/2/2005	23	8:15	-	-	-	53.3
17	Eff	Grab	5/2/2005	23	8:15	-	-	-	44.6
18	Eff	Grab	5/2/2005	23	8:15	-	-	-	49.6
Clar	Eff	Grab	5/2/2005	23	8:15	-	-	-	200
Baker	North	Grab	5/2/2005	23	8:15	-	-	-	312
Limestone	Eff	Grab	5/2/2005	23	8:15	-	-	-	32.9
1	Eff	Grab	5/2/2005	23	17:30	7.8	593	14.2	30.5
2	Eff	Grab	5/2/2005	23	17:30	7.9	601	14.1	25.3
3	Eff	Grab	5/2/2005	23	17:30	7.4	629	14.1	55.5
4	Eff	Grab	5/2/2005	23	17:30	7.4	625	14.1	61.4
5	Eff	Grab	5/2/2005	23	17:30	8.1	587	14.2	44.1
6	Eff	Grab	5/2/2005	23	17:30	8.0	592	14.2	30.8
7	Eff	Grab	5/2/2005	23	17:30	8.2	587	14.2	68.5
8	Eff	Grab	5/2/2005	23	17:30	8.2	588	14.2	60.6
9	Eff	Grab	5/2/2005	23	17:30	7.4	626	14.1	76.1
10	Eff	Grab	5/2/2005	23	17:30	7.4	624	14.1	77.7
11	Eff	Grab	5/2/2005	23	17:30	8.0	656	14.3	54.9
12	Eff	Grab	5/2/2005	23	17:30	8.1	654	14.2	57.8
13	Eff	Grab	5/2/2005	23	17:30	6.9	657	14.4	39.4
14	Eff	Grab	5/2/2005	23	17:30	6.9	662	14.3	39.0
15	Eff	Grab	5/2/2005	23	17:30	5.5	669	14.4	34.8
16	Eff	Grab	5/2/2005	23	17:30	5.8	661	14.4	48.5
17	Eff	Grab	5/2/2005	23	17:30	7.5	609	14.1	39.6
18	Eff	Grab	5/2/2005	23	17:30	7.5	611	14.2	41.5
Clar	Eff	Grab	5/2/2005	23	17:30	7.6	625	12.0	186
Baker	North	Grab	5/2/2005	23	17:30	7.7	615	11.7	282
Limestone	Eff	Grab	5/2/2005	23	17:30	8.6	603	14.3	29.2
1	Eff	Comp	5/3/2005	23	8:45	7.9	587	12.6	22.3
2	Eff	Comp	5/3/2005	23	8:45	7.9	598	12.6	19.7
3	Eff	Comp	5/3/2005	23	8:45	7.4	621	12.6	47.2
4	Eff	Comp	5/3/2005	23	8:45	7.4	599	12.5	50.3
5	Eff	Comp	5/3/2005	23	8:45	8.0	575	12.7	31.2
6	Eff	Comp	5/3/2005	23	8:45	7.9	574	12.7	25.2
7	Eff	Comp	5/3/2005	23	8:45	8.0	573	12.7	51.8
8	Eff	Comp	5/3/2005	23	8:45	8.1	575	12.6	45.6
9	Eff	Comp	5/3/2005	23	8:45	7.5	620	12.5	57.8
10	Eff	Comp	5/3/2005	23	8:45	7.5	623	12.5	64.4
11	Eff	Comp	5/3/2005	23	8:45	8.1	651	12.6	47.5
12	Eff	Comp	5/3/2005	23	8:45	8.1	651	12.6	49.7
13	Eff	Comp	5/3/2005	23	8:45	7.0	644	12.6	40.2
14	Eff	Comp	5/3/2005	23	8:45	6.9	649	12.7	41.0
15	Eff	Comp	5/3/2005	23	8:45	5.0	659	12.7	30.2
16	Eff	Comp	5/3/2005	23	8:45	6.0	646	12.8	46.2
17	Eff	Comp	5/3/2005	23	8:45	7.7	620	12.6	34.0
18	Eff	Comp	5/3/2005	23	8:45	7.6	616	12.6	36.1
Clar	Eff	Comp	5/3/2005	23	8:45	7.6	623	11.0	184
Baker	North	Comp	5/3/2005	23	8:45	7.6	622	13.0	292
Limestone	Eff	Comp	5/3/2005	23	8:45	8.7	619	12.6	25.5
1	Twelve	Grab	5/3/2005	23	13:00	-	-	-	24.3
2	Twelve	Grab	5/3/2005	23	13:00	-	-	-	22.5
3	Twelve	Grab	5/3/2005	23	13:00	-	-	-	56.6
4	Twelve	Grab	5/3/2005	23	13:00	-	-	-	56.3
5	Twelve	Grab	5/3/2005	23	13:00	-	-	-	40.0
6	Twelve	Grab	5/3/2005	23	13:00	-	-	-	35.0
7	Twelve	Grab	5/3/2005	23	13:00	-	-	-	48.9
8	Twelve	Grab	5/3/2005	23	13:00	-	-	-	45.6
9	Twelve	Grab	5/3/2005	23	13:00	-	-	-	63.2

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
10	Twelve	Grab	5/3/2005	23	13:00	-	-	-	72.3
11	Twelve	Grab	5/3/2005	23	13:00	-	-	-	57.3
12	Twelve	Grab	5/3/2005	23	13:00	-	-	-	57.5
13	Twelve	Grab	5/3/2005	23	13:00	-	-	-	80.1
14	Twelve	Grab	5/3/2005	23	13:00	-	-	-	79.5
15	Twelve	Grab	5/3/2005	23	13:00	-	-	-	49.5
16	Twelve	Grab	5/3/2005	23	13:00	-	-	-	58.7
17	Twelve	Grab	5/3/2005	23	13:00	-	-	-	40.2
18	Twelve	Grab	5/3/2005	23	13:00	-	-	-	47.7
F1	Interface	C/G	5/3/2005	23	13:00	-	-	-	189
F2	Interface	C/G	5/3/2005	23	13:00	-	-	-	75.4
F3	Interface	C/G	5/3/2005	23	13:00	-	-	-	190
1	Eff	Grab	5/3/2005	23	15:30	-	-	-	26.2
2	Eff	Grab	5/3/2005	23	15:30	-	-	-	25.6
3	Eff	Grab	5/3/2005	23	15:30	-	-	-	45.5
4	Eff	Grab	5/3/2005	23	15:30	-	-	-	51.2
5	Eff	Grab	5/3/2005	23	15:30	-	-	-	35.2
6	Eff	Grab	5/3/2005	23	15:30	-	-	-	28.5
7	Eff	Grab	5/3/2005	23	15:30	-	-	-	51.2
8	Eff	Grab	5/3/2005	23	15:30	-	-	-	44.9
9	Eff	Grab	5/3/2005	23	15:30	-	-	-	64.6
10	Eff	Grab	5/3/2005	23	15:30	-	-	-	66.1
11	Eff	Grab	5/3/2005	23	15:30	-	-	-	46.5
12	Eff	Grab	5/3/2005	23	15:30	-	-	-	52.4
13	Eff	Grab	5/3/2005	23	15:30	-	-	-	41.9
14	Eff	Grab	5/3/2005	23	15:30	-	-	-	44.6
15	Eff	Grab	5/3/2005	23	15:30	-	-	-	39.0
16	Eff	Grab	5/3/2005	23	15:30	-	-	-	49.5
17	Eff	Grab	5/3/2005	23	15:30	-	-	-	33.7
18	Eff	Grab	5/3/2005	23	15:30	-	-	-	38.1
Clar	Eff	Grab	5/3/2005	23	15:30	-	-	-	177
Baker	North	Grab	5/3/2005	23	15:30	-	-	-	295
Limestone	Eff	Grab	5/3/2005	23	15:30	-	-	-	27.7
1	Eff	Grab	5/4/2005	23	9:00	-	-	-	16.7
2	Eff	Grab	5/4/2005	23	9:00	-	-	-	17.0
3	Eff	Grab	5/4/2005	23	9:00	-	-	-	45.2
4	Eff	Grab	5/4/2005	23	9:00	-	-	-	47.1
5	Eff	Grab	5/4/2005	23	9:00	-	-	-	23.3
6	Eff	Grab	5/4/2005	23	9:00	-	-	-	20.3
7	Eff	Grab	5/4/2005	23	9:00	-	-	-	40.7
8	Eff	Grab	5/4/2005	23	9:00	-	-	-	37.2
9	Eff	Grab	5/4/2005	23	9:00	-	-	-	55.9
10	Eff	Grab	5/4/2005	23	9:00	-	-	-	62.1
11	Eff	Grab	5/4/2005	23	9:00	-	-	-	45.9
12	Eff	Grab	5/4/2005	23	9:00	-	-	-	49.7
13	Eff	Grab	5/4/2005	23	9:00	-	-	-	42.7
14	Eff	Grab	5/4/2005	23	9:00	-	-	-	46.8
15	Eff	Grab	5/4/2005	23	9:00	-	-	-	31.7
16	Eff	Grab	5/4/2005	23	9:00	-	-	-	45.7
17	Eff	Grab	5/4/2005	23	9:00	-	-	-	33.4
18	Eff	Grab	5/4/2005	23	9:00	-	-	-	34.8
Clar	Eff	Grab	5/4/2005	23	9:00	-	-	-	202
Baker	North	Grab	5/4/2005	23	9:00	-	-	-	310
Limestone	Eff	Grab	5/4/2005	23	9:00	-	-	-	21.2
1	Eff	Grab	5/4/2005	23	17:00	7.8	585	13.5	15.5
2	Eff	Grab	5/4/2005	23	17:00	7.9	579	13.5	13.6
3	Eff	Grab	5/4/2005	23	17:00	7.5	629	13.7	47.0
4	Eff	Grab	5/4/2005	23	17:00	7.5	629	13.8	48.7
5	Eff	Grab	5/4/2005	23	17:00	8.0	597	13.6	21.2
6	Eff	Grab	5/4/2005	23	17:00	8.0	591	13.6	18.5

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
7	Eff	Grab	5/4/2005	23	17:00	8.1	585	13.6	40.1
8	Eff	Grab	5/4/2005	23	17:00	8.1	585	13.5	35.4
9	Eff	Grab	5/4/2005	23	17:00	7.4	627	13.8	59.6
10	Eff	Grab	5/4/2005	23	17:00	7.4	627	13.8	65.0
11	Eff	Grab	5/4/2005	23	17:00	8.0	654	13.9	49.2
12	Eff	Grab	5/4/2005	23	17:00	8.1	655	13.5	53.0
13	Eff	Grab	5/4/2005	23	17:00	6.5	646	13.5	42.8
14	Eff	Grab	5/4/2005	23	17:00	6.5	645	13.5	44.5
15	Eff	Grab	5/4/2005	23	17:00	6.0	660	13.8	31.1
16	Eff	Grab	5/4/2005	23	17:00	6.1	653	13.7	46.0
17	Eff	Grab	5/4/2005	23	17:00	7.5	633	13.6	34.8
18	Eff	Grab	5/4/2005	23	17:00	7.5	625	13.7	35.2
Clar	Eff	Grab	5/4/2005	23	17:00	7.6	628	14.6	175
Baker	North	Grab	5/4/2005	23	17:00	7.6	629	15.2	316
Limestone	Eff	Grab	5/4/2005	23	17:00	8.6	627	13.7	18.2
1	Eff	Grab	5/5/2005	23	8:30	-	-	-	12.8
2	Eff	Grab	5/5/2005	23	8:30	-	-	-	10.4
3	Eff	Grab	5/5/2005	23	8:30	-	-	-	41.8
4	Eff	Grab	5/5/2005	23	8:30	-	-	-	43.2
5	Eff	Grab	5/5/2005	23	8:30	-	-	-	18.1
6	Eff	Grab	5/5/2005	23	8:30	-	-	-	14.2
7	Eff	Grab	5/5/2005	23	8:30	-	-	-	31.9
8	Eff	Grab	5/5/2005	23	8:30	-	-	-	32.6
9	Eff	Grab	5/5/2005	23	8:30	-	-	-	57.2
10	Eff	Grab	5/5/2005	23	8:30	-	-	-	51.9
11	Eff	Grab	5/5/2005	23	8:30	-	-	-	46.3
12	Eff	Grab	5/5/2005	23	8:30	-	-	-	49.5
13	Eff	Grab	5/5/2005	23	8:30	-	-	-	43.8
14	Eff	Grab	5/5/2005	23	8:30	-	-	-	44.7
15	Eff	Grab	5/5/2005	23	8:30	-	-	-	31.8
16	Eff	Grab	5/5/2005	23	8:30	-	-	-	42.6
17	Eff	Grab	5/5/2005	23	8:30	-	-	-	32.2
18	Eff	Grab	5/5/2005	23	8:30	-	-	-	32.9
Clar	Eff	Grab	5/5/2005	23	8:30	-	-	-	206
Baker	North	Grab	5/5/2005	23	8:30	-	-	-	324
Limestone	Eff	Grab	5/5/2005	23	8:30	-	-	-	13.7
1	Eff	Grab	5/5/2005	23	17:00	7.8	586	11.5	12.1
2	Eff	Grab	5/5/2005	23	17:00	7.9	579	11.6	8.97
3	Eff	Grab	5/5/2005	23	17:00	7.5	624	11.7	42.9
4	Eff	Grab	5/5/2005	23	17:00	7.5	622	11.7	44.0
5	Eff	Grab	5/5/2005	23	17:00	8.0	603	11.8	16.7
6	Eff	Grab	5/5/2005	23	17:00	8.0	596	12.0	13.2
7	Eff	Grab	5/5/2005	23	17:00	8.1	583	11.9	32.2
8	Eff	Grab	5/5/2005	23	17:00	8.1	586	11.9	30.9
9	Eff	Grab	5/5/2005	23	17:00	7.4	622	11.8	54.8
10	Eff	Grab	5/5/2005	23	17:00	7.4	622	11.8	56.3
11	Eff	Grab	5/5/2005	23	17:00	8.0	652	11.8	46.9
12	Eff	Grab	5/5/2005	23	17:00	8.1	652	11.5	48.9
13	Eff	Grab	5/5/2005	23	17:00	6.7	638	11.6	43.6
14	Eff	Grab	5/5/2005	23	17:00	6.7	639	11.6	43.7
15	Eff	Grab	5/5/2005	23	17:00	5.7	652	11.7	31.1
16	Eff	Grab	5/5/2005	23	17:00	6.2	644	11.7	41.1
17	Eff	Grab	5/5/2005	23	17:00	7.5	629	11.6	32.3
18	Eff	Grab	5/5/2005	23	17:00	7.5	624	11.5	32.9
Clar	Eff	Grab	5/5/2005	23	17:00	7.7	633	12.1	197
Baker	North	Grab	5/5/2005	23	17:00	7.7	622	14.1	308
Limestone	Eff	Grab	5/5/2005	23	17:00	8.5	602	11.8	12.2
1	Eff	Grab	5/6/2005	23	8:45	-	-	-	11.6
2	Eff	Grab	5/6/2005	23	8:45	-	-	-	8.26
3	Eff	Grab	5/6/2005	23	8:45	-	-	-	40.7
4	Eff	Grab	5/6/2005	23	8:45	-	-	-	43.1

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
5	Eff	Grab	5/6/2005	23	8:45	-	-	-	16.3
6	Eff	Grab	5/6/2005	23	8:45	-	-	-	13.1
7	Eff	Grab	5/6/2005	23	8:45	-	-	-	29.4
8	Eff	Grab	5/6/2005	23	8:45	-	-	-	30.2
9	Eff	Grab	5/6/2005	23	8:45	-	-	-	51.5
10	Eff	Grab	5/6/2005	23	8:45	-	-	-	51.7
11	Eff	Grab	5/6/2005	23	8:45	-	-	-	46.7
12	Eff	Grab	5/6/2005	23	8:45	-	-	-	48.0
13	Eff	Grab	5/6/2005	23	8:45	-	-	-	45.6
14	Eff	Grab	5/6/2005	23	8:45	-	-	-	45.7
15	Eff	Grab	5/6/2005	23	8:45	-	-	-	32.9
16	Eff	Grab	5/6/2005	23	8:45	-	-	-	41.9
17	Eff	Grab	5/6/2005	23	8:45	-	-	-	30.4
18	Eff	Grab	5/6/2005	23	8:45	-	-	-	33.4
Clar	Eff	Grab	5/6/2005	23	8:45	-	-	-	197
Baker	North	Grab	5/6/2005	23	8:45	-	-	-	329
Limestone	Eff	Grab	5/6/2005	23	8:45	-	-	-	11.8
1	Eff	Grab	5/6/2005	23	15:30	7.9	598	10.8	12.6
2	Eff	Grab	5/6/2005	23	15:30	8.0	591	10.9	7.95
3	Eff	Grab	5/6/2005	23	15:30	7.5	627	10.7	41.7
4	Eff	Grab	5/6/2005	23	15:30	7.5	625	10.8	42.4
5	Eff	Grab	5/6/2005	23	15:30	8.0	609	11.0	17.4
6	Eff	Grab	5/6/2005	23	15:30	8.1	608	11.1	11.8
7	Eff	Grab	5/6/2005	23	15:30	8.2	598	11.0	31.5
8	Eff	Grab	5/6/2005	23	15:30	8.2	600	11.1	32.1
9	Eff	Grab	5/6/2005	23	15:30	7.5	624	10.9	49.0
10	Eff	Grab	5/6/2005	23	15:30	7.5	624	10.9	54.3
11	Eff	Grab	5/6/2005	23	15:30	8.1	649	11.1	47.7
12	Eff	Grab	5/6/2005	23	15:30	8.1	648	11.0	51.7
13	Eff	Grab	5/6/2005	23	15:30	6.7	641	11.1	46.3
14	Eff	Grab	5/6/2005	23	15:30	6.7	641	11.2	47.9
15	Eff	Grab	5/6/2005	23	15:30	5.9	654	11.2	34.2
16	Eff	Grab	5/6/2005	23	15:30	6.4	645	11.3	41.7
17	Eff	Grab	5/6/2005	23	15:30	7.5	625	10.8	33.4
18	Eff	Grab	5/6/2005	23	15:30	7.4	623	10.8	33.3
Clar	Eff	Grab	5/6/2005	23	15:30	7.9	627	12.3	214
Baker	North	Grab	5/6/2005	23	15:30	7.8	626	15.1	317
Limestone	Eff	Grab	5/6/2005	23	15:30	8.5	612	11.2	12.8
1	Eff	Grab	5/7/2005	23	9:00	8.0	610	11.0	12.1
2	Eff	Grab	5/7/2005	23	9:00	8.0	604	11.0	8.50
3	Eff	Grab	5/7/2005	23	9:00	7.5	624	11.0	38.7
4	Eff	Grab	5/7/2005	23	9:00	7.5	627	11.1	41.3
5	Eff	Grab	5/7/2005	23	9:00	8.1	613	11.0	15.5
6	Eff	Grab	5/7/2005	23	9:00	8.1	615	11.1	12.1
7	Eff	Grab	5/7/2005	23	9:00	8.2	610	11.1	24.9
8	Eff	Grab	5/7/2005	23	9:00	8.2	613	11.1	30.0
9	Eff	Grab	5/7/2005	23	9:00	7.4	629	11.1	47.8
10	Eff	Grab	5/7/2005	23	9:00	7.4	625	11.1	49.9
11	Eff	Grab	5/7/2005	23	9:00	8.1	650	11.0	45.4
12	Eff	Grab	5/7/2005	23	9:00	8.1	650	11.0	48.4
13	Eff	Grab	5/7/2005	23	9:00	6.5	642	11.1	46.6
14	Eff	Grab	5/7/2005	23	9:00	6.5	643	11.1	46.7
15	Eff	Grab	5/7/2005	23	9:00	5.7	680	10.4	33.9
16	Eff	Grab	5/7/2005	23	9:00	6.4	648	11.0	40.7
17	Eff	Grab	5/7/2005	23	9:00	7.4	629	11.0	27.2
18	Eff	Grab	5/7/2005	23	9:00	7.4	624	11.0	31.1
Clar	Eff	Grab	5/7/2005	23	9:00	7.9	624	11.2	222
Baker	North	Grab	5/7/2005	23	9:00	7.9	624	12.0	377
Limestone	Eff	Grab	5/7/2005	23	9:00	8.4	620	11.1	9.89
1	Eff	Grab	5/14/2005	24	16:30	-	-	-	-
2	Eff	Grab	5/14/2005	24	16:30	-	-	-	-

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
3	Eff	Grab	5/14/2005	24	16:30	-	-	-	55.2
4	Eff	Grab	5/14/2005	24	16:30	-	-	-	47.3
5	Eff	Grab	5/14/2005	24	16:30	-	-	-	2.54
6	Eff	Grab	5/14/2005	24	16:30	-	-	-	2.98
7	Eff	Grab	5/14/2005	24	16:30	-	-	-	-
8	Eff	Grab	5/14/2005	24	16:30	-	-	-	9.69
9	Eff	Grab	5/14/2005	24	16:30	-	-	-	8.30
10	Eff	Grab	5/14/2005	24	16:30	-	-	-	56.3
11	Eff	Grab	5/14/2005	24	16:30	-	-	-	9.21
12	Eff	Grab	5/14/2005	24	16:30	-	-	-	17.5
13	Eff	Grab	5/14/2005	24	16:30	-	-	-	20.5
14	Eff	Grab	5/14/2005	24	16:30	-	-	-	4.68
15	Eff	Grab	5/14/2005	24	16:30	-	-	-	5.50
16	Eff	Grab	5/14/2005	24	16:30	-	-	-	4.45
17	Eff	Grab	5/14/2005	24	16:30	-	-	-	-
18	Eff	Grab	5/14/2005	24	16:30	-	-	-	4.39
Clar	Eff	Grab	5/14/2005	24	16:30	-	-	-	314
Baker	North	Grab	5/14/2005	24	16:30	-	-	-	441
Limestone	Eff	Grab	5/14/2005	24	16:30	-	-	-	-
1	Eff	Grab	5/15/2005	24	9:30	8.6	642	13.9	0.680
2	Eff	Grab	5/15/2005	24	9:30	8.6	637	14.1	0.632
3	Eff	Grab	5/15/2005	24	9:30	7.6	444	13.3	181
4	Eff	Grab	5/15/2005	24	9:30	7.9	445	14.0	187
5	Eff	Grab	5/15/2005	24	9:30	8.4	506	13.7	0.563
6	Eff	Grab	5/15/2005	24	9:30	8.4	525	13.9	3.19
7	Eff	Grab	5/15/2005	24	9:30	8.5	641	14.5	2.69
8	Eff	Grab	5/15/2005	24	9:30	8.4	507	13.8	13.5
9	Eff	Grab	5/15/2005	24	9:30	7.7	444	14.1	192
10	Eff	Grab	5/15/2005	24	9:30	7.6	496	14.1	199
11	Eff	Grab	5/15/2005	24	9:30	8.6	495	14.0	144
12	Eff	Grab	5/15/2005	24	9:30	8.6	478	13.8	149
13	Eff	Grab	5/15/2005	24	9:30	6.9	515	13.8	37.9
14	Eff	Grab	5/15/2005	24	9:30	7.0	514	13.8	42.4
15	Eff	Grab	5/15/2005	24	9:30	6.2	680	13.9	0.507
16	Eff	Grab	5/15/2005	24	9:30	6.0	584	13.7	6.10
17	Eff	Grab	5/15/2005	24	9:30	8.0	667	14.4	3.57
18	Eff	Grab	5/15/2005	24	9:30	7.7	511	13.7	8.26
Clar	Eff	Grab	5/15/2005	24	9:30	8.1	445	13.5	337
Baker	North	Grab	5/15/2005	24	9:30	8.1	440	13.8	390
Limestone	Eff	Grab	5/15/2005	24	9:30	8.8	606	14.4	2.68
1	Eff	Grab	5/15/2005	24	16:30	-	-	-	-
2	Eff	Grab	5/15/2005	24	16:30	-	-	-	-
3	Eff	Grab	5/15/2005	24	16:30	-	-	-	188
4	Eff	Grab	5/15/2005	24	16:30	-	-	-	226
5	Eff	Grab	5/15/2005	24	16:30	-	-	-	4.34
6	Eff	Grab	5/15/2005	24	16:30	-	-	-	4.09
7	Eff	Grab	5/15/2005	24	16:30	-	-	-	-
8	Eff	Grab	5/15/2005	24	16:30	-	-	-	39.2
9	Eff	Grab	5/15/2005	24	16:30	-	-	-	256
10	Eff	Grab	5/15/2005	24	16:30	-	-	-	249
11	Eff	Grab	5/15/2005	24	16:30	-	-	-	165
12	Eff	Grab	5/15/2005	24	16:30	-	-	-	179
13	Eff	Grab	5/15/2005	24	16:30	-	-	-	56.8
14	Eff	Grab	5/15/2005	24	16:30	-	-	-	44.7
15	Eff	Grab	5/15/2005	24	16:30	-	-	-	3.09
16	Eff	Grab	5/15/2005	24	16:30	-	-	-	22.8
17	Eff	Grab	5/15/2005	24	16:30	-	-	-	4.54
18	Eff	Grab	5/15/2005	24	16:30	-	-	-	9.79
Clar	Eff	Grab	5/15/2005	24	16:30	-	-	-	384
Baker	North	Grab	5/15/2005	24	16:30	-	-	-	429
Limestone	Eff	Grab	5/15/2005	24	16:30	-	-	-	-

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
1	Eff	Grab	5/16/2005	24	10:00	-	-	-	-
2	Eff	Grab	5/16/2005	24	10:00	-	-	-	-
3	Eff	Grab	5/16/2005	24	10:00	7.6	439	13.6	175
4	Eff	Grab	5/16/2005	24	10:00	7.8	443	13.6	199
5	Eff	Grab	5/16/2005	24	10:00	8.3	439	13.5	1.60
6	Eff	Grab	5/16/2005	24	10:00	8.4	454	13.5	0.507
7	Eff	Grab	5/16/2005	24	10:00	8.5	500	13.5	8.30
8	Eff	Grab	5/16/2005	24	10:00	8.5	504	13.6	33.8
9	Eff	Grab	5/16/2005	24	10:00	7.6	440	13.7	207
10	Eff	Grab	5/16/2005	24	10:00	7.6	445	13.7	223
11	Eff	Grab	5/16/2005	24	10:00	8.8	472	13.6	153
12	Eff	Grab	5/16/2005	24	10:00	8.8	467	13.6	155
13	Eff	Grab	5/16/2005	24	10:00	6.7	468	13.7	76.2
14	Eff	Grab	5/16/2005	24	10:00	6.8	473	13.7	68.0
15	Eff	Grab	5/16/2005	24	10:00	5.1	585	13.5	0.681
16	Eff	Grab	5/16/2005	24	10:00	5.5	522	13.6	3.13
17	Eff	Grab	5/16/2005	24	10:00	7.8	477	13.6	1.75
18	Eff	Grab	5/16/2005	24	10:00	7.8	492	13.7	80.3
Clar	Eff	Grab	5/16/2005	24	10:00	7.9	438	13.4	347
Baker	North	Grab	5/16/2005	24	10:00	8.1	437	14.0	437
Limestone	Eff	Grab	5/16/2005	24	10:00	8.7	470	13.5	0.537
1	Eff	Grab	5/16/2005	24	15:00	-	-	-	2.26
2	Eff	Grab	5/16/2005	24	15:00	-	-	-	1.47
3	Eff	Grab	5/16/2005	24	15:00	-	-	-	179
4	Eff	Grab	5/16/2005	24	15:00	-	-	-	191
5	Eff	Grab	5/16/2005	24	15:00	-	-	-	1.40
6	Eff	Grab	5/16/2005	24	15:00	-	-	-	0.606
7	Eff	Grab	5/16/2005	24	15:00	-	-	-	10.1
8	Eff	Grab	5/16/2005	24	15:00	-	-	-	41.6
9	Eff	Grab	5/16/2005	24	15:00	-	-	-	217
10	Eff	Grab	5/16/2005	24	15:00	-	-	-	225
11	Eff	Grab	5/16/2005	24	15:00	-	-	-	147
12	Eff	Grab	5/16/2005	24	15:00	-	-	-	153
13	Eff	Grab	5/16/2005	24	15:00	-	-	-	81.1
14	Eff	Grab	5/16/2005	24	15:00	-	-	-	71.8
15	Eff	Grab	5/16/2005	24	15:00	-	-	-	0.550
16	Eff	Grab	5/16/2005	24	15:00	-	-	-	3.19
17	Eff	Grab	5/16/2005	24	15:00	-	-	-	3.04
18	Eff	Grab	5/16/2005	24	15:00	-	-	-	115
Clar	Eff	Grab	5/16/2005	24	15:00	-	-	-	330
Baker	North	Grab	5/16/2005	24	15:00	-	-	-	431
Limestone	Eff	Grab	5/16/2005	24	15:00	-	-	-	2.17
1	Eff	Comp	5/17/2005	24	10:00	8.0	468	12.3	0.801
2	Eff	Comp	5/17/2005	24	10:00	8.3	507	12.2	0.986
3	Eff	Comp	5/17/2005	24	10:00	7.4	417	12.2	172
4	Eff	Comp	5/17/2005	24	10:00	7.7	426	12.1	180
5	Eff	Comp	5/17/2005	24	10:00	8.4	469	12.2	0.996
6	Eff	Comp	5/17/2005	24	10:00	8.1	469	12.2	0.805
7	Eff	Comp	5/17/2005	24	10:00	8.4	479	12.3	12.3
8	Eff	Comp	5/17/2005	24	10:00	8.5	484	12.5	41.3
9	Eff	Comp	5/17/2005	24	10:00	7.7	420	12.5	186
10	Eff	Comp	5/17/2005	24	10:00	7.8	417	12.5	200
11	Eff	Comp	5/17/2005	24	10:00	8.9	445	12.2	144
12	Eff	Comp	5/17/2005	24	10:00	8.4	444	12.4	144
13	Eff	Comp	5/17/2005	24	10:00	6.9	433	12.3	93.6
14	Eff	Comp	5/17/2005	24	10:00	7.0	438	12.3	76.4
15	Eff	Comp	5/17/2005	24	10:00	5.2	523	12.6	1.63
16	Eff	Comp	5/17/2005	24	10:00	5.1	505	12.5	3.26
17	Eff	Comp	5/17/2005	24	10:00	7.3	477	12.5	1.92
18	Eff	Comp	5/17/2005	24	10:00	7.5	444	12.5	127
Clar	Eff	Comp	5/17/2005	24	10:00	8.0	422	11.7	344
Baker	North	Comp	5/17/2005	24	10:00	8.1	417	13.2	501

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
Limestone	Eff	Comp	5/17/2005	24	10:00	8.4	449	12.8	0.911
1	Twelve	Grab	5/17/2005	24	10:30	-	-	-	9.86
2	Twelve	Grab	5/17/2005	24	10:30	-	-	-	10.9
3	Twelve	Grab	5/17/2005	24	10:30	-	-	-	361
4	Twelve	Grab	5/17/2005	24	10:30	-	-	-	190
5	Twelve	Grab	5/17/2005	24	10:30	-	-	-	42.0
6	Twelve	Grab	5/17/2005	24	10:30	-	-	-	32.6
7	Twelve	Grab	5/17/2005	24	10:30	-	-	-	259
8	Twelve	Grab	5/17/2005	24	10:30	-	-	-	169
9	Twelve	Grab	5/17/2005	24	10:30	-	-	-	278
10	Twelve	Grab	5/17/2005	24	10:30	-	-	-	220
11	Twelve	Grab	5/17/2005	24	10:30	-	-	-	184
12	Twelve	Grab	5/17/2005	24	10:30	-	-	-	171
13	Twelve	Grab	5/17/2005	24	10:30	-	-	-	237
14	Twelve	Grab	5/17/2005	24	10:30	-	-	-	246
15	Twelve	Grab	5/17/2005	24	10:30	-	-	-	9.19
16	Twelve	Grab	5/17/2005	24	10:30	-	-	-	65.3
17	Twelve	Grab	5/17/2005	24	10:30	-	-	-	117
18	Twelve	Grab	5/17/2005	24	10:30	-	-	-	223
F1	Interface	C/G	5/17/2005	24	11:00	-	-	-	1213
F2	Interface	C/G	5/17/2005	24	11:00	-	-	-	346
F3	Interface	C/G	5/17/2005	24	11:00	-	-	-	935
1	Eff	Grab	5/17/2005	24	15:30	-	-	-	2.75
2	Eff	Grab	5/17/2005	24	15:30	-	-	-	1.03
3	Eff	Grab	5/17/2005	24	15:30	-	-	-	205
4	Eff	Grab	5/17/2005	24	15:30	-	-	-	194
5	Eff	Grab	5/17/2005	24	15:30	-	-	-	2.52
6	Eff	Grab	5/17/2005	24	15:30	-	-	-	3.90
7	Eff	Grab	5/17/2005	24	15:30	-	-	-	57.2
8	Eff	Grab	5/17/2005	24	15:30	-	-	-	60.5
9	Eff	Grab	5/17/2005	24	15:30	-	-	-	198
10	Eff	Grab	5/17/2005	24	15:30	-	-	-	194
11	Eff	Grab	5/17/2005	24	15:30	-	-	-	158
12	Eff	Grab	5/17/2005	24	15:30	-	-	-	164
13	Eff	Grab	5/17/2005	24	15:30	-	-	-	109
14	Eff	Grab	5/17/2005	24	15:30	-	-	-	96.2
15	Eff	Grab	5/17/2005	24	15:30	-	-	-	1.66
16	Eff	Grab	5/17/2005	24	15:30	-	-	-	9.67
17	Eff	Grab	5/17/2005	24	15:30	-	-	-	83.2
18	Eff	Grab	5/17/2005	24	15:30	-	-	-	153
Clar	Eff	Grab	5/17/2005	24	15:30	-	-	-	341
Baker	North	Grab	5/17/2005	24	15:30	-	-	-	392
Limestone	Eff	Grab	5/17/2005	24	15:30	-	-	-	1.58
1	Eff	Grab	5/18/2005	24	9:00	8.4	452	13.0	1.31
2	Eff	Grab	5/18/2005	24	9:00	8.3	454	13.1	2.36
3	Eff	Grab	5/18/2005	24	9:00	7.5	419	13.2	171
4	Eff	Grab	5/18/2005	24	9:00	7.7	419	13.0	168
5	Eff	Grab	5/18/2005	24	9:00	8.4	481	13.1	6.67
6	Eff	Grab	5/18/2005	24	9:00	8.2	480	13.1	1.61
7	Eff	Grab	5/18/2005	24	9:00	8.6	482	13.1	56.0
8	Eff	Grab	5/18/2005	24	9:00	8.5	470	13.1	61.8
9	Eff	Grab	5/18/2005	24	9:00	7.5	417	13.2	176
10	Eff	Grab	5/18/2005	24	9:00	7.7	417	13.3	173
11	Eff	Grab	5/18/2005	24	9:00	9.2	444	13.2	141
12	Eff	Grab	5/18/2005	24	9:00	8.7	441	13.1	138
13	Eff	Grab	5/18/2005	24	9:00	7.1	427	13.1	114
14	Eff	Grab	5/18/2005	24	9:00	7.3	426	13.0	108
15	Eff	Grab	5/18/2005	24	9:00	4.9	537	13.1	1.58
16	Eff	Grab	5/18/2005	24	9:00	7.8	492	13.1	19.0
17	Eff	Grab	5/18/2005	24	9:00	7.5	443	13.0	116

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
18	Eff	Grab	5/18/2005	24	9:00	7.6	424	13.0	147
Clar	Eff	Grab	5/18/2005	24	9:00	8.5	417	12.8	312
Baker	North	Grab	5/18/2005	24	9:00	8.2	417	13.8	421
Limestone	Eff	Grab	5/18/2005	24	9:00	8.8	484	13.1	2.61
1	Eff	Grab	5/18/2005	24	15:30	-	-	-	2.19
2	Eff	Grab	5/18/2005	24	15:30	-	-	-	1.31
3	Eff	Grab	5/18/2005	24	15:30	-	-	-	169
4	Eff	Grab	5/18/2005	24	15:30	-	-	-	171
5	Eff	Grab	5/18/2005	24	15:30	-	-	-	8.18
6	Eff	Grab	5/18/2005	24	15:30	-	-	-	4.11
7	Eff	Grab	5/18/2005	24	15:30	-	-	-	54.3
8	Eff	Grab	5/18/2005	24	15:30	-	-	-	65.7
9	Eff	Grab	5/18/2005	24	15:30	-	-	-	173
10	Eff	Grab	5/18/2005	24	15:30	-	-	-	172
11	Eff	Grab	5/18/2005	24	15:30	-	-	-	140
12	Eff	Grab	5/18/2005	24	15:30	-	-	-	141
13	Eff	Grab	5/18/2005	24	15:30	-	-	-	115
14	Eff	Grab	5/18/2005	24	15:30	-	-	-	121
15	Eff	Grab	5/18/2005	24	15:30	-	-	-	2.61
16	Eff	Grab	5/18/2005	24	15:30	-	-	-	41.6
17	Eff	Grab	5/18/2005	24	15:30	-	-	-	121
18	Eff	Grab	5/18/2005	24	15:30	-	-	-	144
Clar	Eff	Grab	5/18/2005	24	15:30	-	-	-	316
Baker	North	Grab	5/18/2005	24	15:30	-	-	-	436
Limestone	Eff	Grab	5/18/2005	24	15:30	-	-	-	5.51
1	Eff	Grab	5/19/2005	24	8:30	8.8	461	13.2	9.76
2	Eff	Grab	5/19/2005	24	8:30	8.8	456	13.2	7.36
3	Eff	Grab	5/19/2005	24	8:30	7.7	419	13.2	150
4	Eff	Grab	5/19/2005	24	8:30	7.9	417	13.2	150
5	Eff	Grab	5/19/2005	24	8:30	8.7	467	13.3	25.1
6	Eff	Grab	5/19/2005	24	8:30	8.7	462	13.1	4.71
7	Eff	Grab	5/19/2005	24	8:30	8.2	483	13.4	62.7
8	Eff	Grab	5/19/2005	24	8:30	8.7	460	13.3	72.8
9	Eff	Grab	5/19/2005	24	8:30	7.8	419	13.2	147
10	Eff	Grab	5/19/2005	24	8:30	7.7	416	13.4	153
11	Eff	Grab	5/19/2005	24	8:30	9.1	443	13.4	123
12	Eff	Grab	5/19/2005	24	8:30	8.9	443	13.2	133
13	Eff	Grab	5/19/2005	24	8:30	7.3	426	13.2	122
14	Eff	Grab	5/19/2005	24	8:30	7.5	426	13.2	119
15	Eff	Grab	5/19/2005	24	8:30	4.8	525	13.4	0.800
16	Eff	Grab	5/19/2005	24	8:30	5.4	490	13.4	4.08
17	Eff	Grab	5/19/2005	24	8:30	7.9	426	13.4	120
18	Eff	Grab	5/19/2005	24	8:30	7.8	419	13.2	140
Clar	Eff	Grab	5/19/2005	24	8:30	8.4	417	13.2	301
Baker	North	Grab	5/19/2005	24	8:30	8.2	417	14.0	417
Limestone	Eff	Grab	5/19/2005	24	8:30	8.7	476	13.2	6.39
1	Eff	Grab	5/19/2005	24	14:30	-	-	-	11.5
2	Eff	Grab	5/19/2005	24	14:30	-	-	-	3.58
3	Eff	Grab	5/19/2005	24	14:30	-	-	-	148
4	Eff	Grab	5/19/2005	24	14:30	-	-	-	159
5	Eff	Grab	5/19/2005	24	14:30	-	-	-	18.7
6	Eff	Grab	5/19/2005	24	14:30	-	-	-	2.69
7	Eff	Grab	5/19/2005	24	14:30	-	-	-	65.1
8	Eff	Grab	5/19/2005	24	14:30	-	-	-	77.6
9	Eff	Grab	5/19/2005	24	14:30	-	-	-	156
10	Eff	Grab	5/19/2005	24	14:30	-	-	-	151
11	Eff	Grab	5/19/2005	24	14:30	-	-	-	136
12	Eff	Grab	5/19/2005	24	14:30	-	-	-	186
13	Eff	Grab	5/19/2005	24	14:30	-	-	-	128
14	Eff	Grab	5/19/2005	24	14:30	-	-	-	114
15	Eff	Grab	5/19/2005	24	14:30	-	-	-	8.06

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
16	Eff	Grab	5/19/2005	24	14:30	-	-	-	34.1
17	Eff	Grab	5/19/2005	24	14:30	-	-	-	119
18	Eff	Grab	5/19/2005	24	14:30	-	-	-	152
Clar	Eff	Grab	5/19/2005	24	14:30	-	-	-	346
Baker	North	Grab	5/19/2005	24	14:30	-	-	-	394
Limestone	Eff	Grab	5/19/2005	24	14:30	-	-	-	5.14
1	Eff	Grab	5/20/2005	24	8:10	7.9	482	14.2	15.3
2	Eff	Grab	5/20/2005	24	8:10	8.2	485	14.2	2.61
3	Eff	Grab	5/20/2005	24	8:10	7.2	406	14.2	134
4	Eff	Grab	5/20/2005	24	8:10	7.3	405	14.3	142
5	Eff	Grab	5/20/2005	24	8:10	8.4	425	14.3	30.1
6	Eff	Grab	5/20/2005	24	8:10	8.5	471	14.2	5.31
7	Eff	Grab	5/20/2005	24	8:10	8.6	461	14.3	78.2
8	Eff	Grab	5/20/2005	24	8:10	8.6	454	14.3	85.1
9	Eff	Grab	5/20/2005	24	8:10	7.4	418	14.3	130
10	Eff	Grab	5/20/2005	24	8:10	7.2	412	14.2	134
11	Eff	Grab	5/20/2005	24	8:10	8.8	447	14.3	113
12	Eff	Grab	5/20/2005	24	8:10	8.9	447	14.2	117
13	Eff	Grab	5/20/2005	24	8:10	6.8	425	14.3	114
14	Eff	Grab	5/20/2005	24	8:10	6.9	426	14.3	104
15	Eff	Grab	5/20/2005	24	8:10	5.1	444	14.3	52.3
16	Eff	Grab	5/20/2005	24	8:10	6.0	429	14.2	96.9
17	Eff	Grab	5/20/2005	24	8:10	7.4	420	14.2	113
18	Eff	Grab	5/20/2005	24	8:10	7.5	418	14.3	133
Clar	Eff	Grab	5/20/2005	24	8:10	8.5	419	14.3	317
Baker	North	Grab	5/20/2005	24	8:10	8.3	420	15.0	409
Limestone	Eff	Grab	5/20/2005	24	8:10	8.7	480	14.2	3.35
1	Eff	Grab	5/20/2005	24	14:50	-	-	-	16.9
2	Eff	Grab	5/20/2005	24	14:50	-	-	-	8.94
3	Eff	Grab	5/20/2005	24	14:50	-	-	-	134
4	Eff	Grab	5/20/2005	24	14:50	-	-	-	145
5	Eff	Grab	5/20/2005	24	14:50	-	-	-	33.4
6	Eff	Grab	5/20/2005	24	14:50	-	-	-	37.7
7	Eff	Grab	5/20/2005	24	14:50	-	-	-	86.2
8	Eff	Grab	5/20/2005	24	14:50	-	-	-	90.4
9	Eff	Grab	5/20/2005	24	14:50	-	-	-	134
10	Eff	Grab	5/20/2005	24	14:50	-	-	-	133
11	Eff	Grab	5/20/2005	24	14:50	-	-	-	117
12	Eff	Grab	5/20/2005	24	14:50	-	-	-	119
13	Eff	Grab	5/20/2005	24	14:50	-	-	-	116
14	Eff	Grab	5/20/2005	24	14:50	-	-	-	101
15	Eff	Grab	5/20/2005	24	14:50	-	-	-	115
16	Eff	Grab	5/20/2005	24	14:50	-	-	-	102
17	Eff	Grab	5/20/2005	24	14:50	-	-	-	115
18	Eff	Grab	5/20/2005	24	14:50	-	-	-	147
Clar	Eff	Grab	5/20/2005	24	14:50	-	-	-	321
Baker	North	Grab	5/20/2005	24	14:50	-	-	-	419
Limestone	Eff	Grab	5/20/2005	24	14:50	-	-	-	31.4
1	Eff	Grab	5/21/2005	24	8:30	8.2	473	13.6	40.3
2	Eff	Grab	5/21/2005	24	8:30	8.2	475	13.6	27.2
3	Eff	Grab	5/21/2005	24	8:30	7.1	415	13.5	120
4	Eff	Grab	5/21/2005	24	8:30	7.3	418	13.7	128
5	Eff	Grab	5/21/2005	24	8:30	7.8	460	13.6	52.4
6	Eff	Grab	5/21/2005	24	8:30	8.1	476	13.5	7.50
7	Eff	Grab	5/21/2005	24	8:30	8.3	445	13.4	101
8	Eff	Grab	5/21/2005	24	8:30	8.3	440	13.6	91.0
9	Eff	Grab	5/21/2005	24	8:30	7.3	419	13.7	112
10	Eff	Grab	5/21/2005	24	8:30	7.3	419	13.6	117
11	Eff	Grab	5/21/2005	24	8:30	8.6	447	13.8	95.7
12	Eff	Grab	5/21/2005	24	8:30	8.6	450	13.7	96.8
13	Eff	Grab	5/21/2005	24	8:30	6.6	425	13.6	102

Table B-21 (Continued). 4-Inch Column Field Water Quality Data

Location	Type	Sample	Date	Run	Time	pH	EC	Temp	Turb
14	Eff	Grab	5/21/2005	24	8:30	6.7	423	13.6	88.4
15	Eff	Grab	5/21/2005	24	8:30	6.0	420	13.7	103
16	Eff	Grab	5/21/2005	24	8:30	6.6	457	13.7	127
17	Eff	Grab	5/21/2005	24	8:30	7.3	421	13.7	106
18	Eff	Grab	5/21/2005	24	8:30	7.3	421	13.7	128
Clar	Eff	Grab	5/21/2005	24	8:30	8.2	425	14.0	326
Baker	North	Grab	5/21/2005	24	8:30	8.0	418	15.9	404
Limestone	Eff	Grab	5/21/2005	24	8:30	8.3	494	13.4	5.88

Table B-22. 4-Inch Filter Column Interface and 12" Depth Samples

Unit	Parameter	Units	RUN 17A	RUN 18	RUN 19	RUN 20	RUN 21	RUN 22	RUN 23	RUN 24
1-T	Filter Media	(desc.)	Existing AA	Existing AA	Existing AA	Existing AA	Existing AA	Existing AA	Existing AA	Existing AA
1-T	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
1-T	Flow Started	(date)	Column not run	11-Dec-04	18-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
1-T	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
1-T	Pilot Log #	(#)		18-1T	19-1T	20-1T	21-1T	22-1T	23-1T	24-1T
1-T	Lab ID #	(#)		0412287-02	0412440-14	0503361-01	0503550-01	0504465-01	0505150-01	0505423-08
1-T	Turbidity (field)	NTU		8.5	101	5.8	19.5	28.1	24.3	9.86
1-T	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
1-T	Phosphorus - total	mg-P/L		< 0.03	0.03	0.03	< 0.03	0.29	< 0.03	< 0.03
2-T	Filter Media	(desc.)	Existing AA	Existing AA	Existing AA	Existing AA	Existing AA	Existing AA	Existing AA	Existing AA
2-T	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
2-T	Flow Started	(date)	Column not run	11-Dec-04	18-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
2-T	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
2-T	Pilot Log #	(#)		18-2T	19-2T	20-2T	21-2T	22-2T	23-2T	24-2T
2-T	Lab ID #	(#)		0412287-03	0412447-07	0503367-01	0503550-07	0504466-01	0505150-02	0505423-09
2-T	Turbidity (field)	NTU		9.9	86.0	98.5	18	31	22.5	10.9
2-T	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.11	< 0.03	< 0.03
2-T	Phosphorus - total	mg-P/L		< 0.03	0.03	0.08	< 0.03	0.30	< 0.03	< 0.03
3-T	Filter Media	(desc.)	Existing Sand	Existing Sand	Existing Sand	Existing Sand	Existing Sand	Existing Sand	Existing Sand	Existing Sand
3-T	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
3-T	Flow Started	(date)	Column not run	11-Dec-04	18-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
3-T	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
3-T	Pilot Log #	(#)		18-3T	19-3T	20-3T	21-3T	22-3T	23-3T	24-3T
3-T	Lab ID #	(#)		0412296-03	0412447-08	0503361-02	0503550-08	0504465-02	0505150-03	0505423-05
3-T	Turbidity (field)	NTU		30.7	284	225	37	88.9	56.6	361
3-T	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.23	0.23	0.29
3-T	Phosphorus - total	mg-P/L		< 0.03	0.08	0.12	0.06	0.39	0.27	0.55
4-T	Filter Media	(desc.)	Existing Sand	Existing Sand	Existing Sand	Existing Sand	Existing Sand	Existing Sand	Existing Sand	Existing Sand
4-T	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
4-T	Flow Started	(date)	Column not run	11-Dec-04	18-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
4-T	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
4-T	Pilot Log #	(#)		18-4T	19-4T	20-4T	21-4T	22-4T	23-4T	24-4T
4-T	Lab ID #	(#)		0412296-02	0412440-04	0503367-02	0503550-02	0504466-02	0505150-04	0505422-05
4-T	Turbidity (field)	NTU		28.1	179	250	36.6	66.3	56.3	190
4-T	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.22	0.27	0.27
4-T	Phosphorus - total	mg-P/L		< 0.03	0.05	0.11	0.05	0.52	0.31	0.41
5-T	Filter Media	(desc.)	AA (28/48)	AA (28/48)	AA (28/48)	AA (28/48)	AA (28/48)	AA (28/48)	AA (28/48)	AA (28/48)
5-T	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
5-T	Flow Started	(date)	Column not run	11-Dec-04	18-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
5-T	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
5-T	Pilot Log #	(#)		18-5T	19-5T	20-5T	21-5T	22-5T	23-5T	24-5T
5-T	Lab ID #	(#)		0412296-01	0412440-02	0503367-03	0503550-09	0504465-03	0505150-05	0505423-10
5-T	Turbidity (field)	NTU		1.6	170	138	21.9	43.1	40	42
5-T	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.10	< 0.03	< 0.03
5-T	Phosphorus - total	mg-P/L		< 0.03	< 0.03	0.08	< 0.03	0.15	< 0.03	< 0.03

Table B-22 (Continued). 4-Inch Filter Column Interface and 12" Depth Samples

Unit	Parameter	Units	RUN 17A	RUN 18	RUN 19	RUN 20	RUN 21	RUN 22	RUN 23	RUN 24
6-T	Filter Media	(desc.)	AA (28/48)	AA (28/48)	AA (28/48)	AA (28/48)	AA (28/48)	AA (28/48)	AA (28/48)	AA (28/48)
6-T	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
6-T	Flow Started	(date)	Column not run	11-Dec-04	18-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
6-T	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
6-T	Pilot Log #	(#)		18-6T	19-6T	20-6T	21-6T	22-6T	23-6T	24-6T
6-T	Lab ID #	(#)		0412287-01	0412447-09	0503361-03	0503550-03	0504466-03	0505150-06	0505423-11
6-T	Turbidity (field)	NTU		1.1	210	102	22	40.2	35	32.6
6-T	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	0.03	< 0.03	0.06	< 0.03	< 0.03
6-T	Phosphorus - total	mg-P/L		< 0.03	0.05	0.14	< 0.03	0.14	< 0.03	< 0.03
7-T	Filter Media	(desc.)	AA (14/28)	AA (14/28)	AA (14/28)	AA (14/28)	AA (14/28)	AA (14/28)	AA (14/28)	AA (14/28)
7-T	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
7-T	Flow Started	(date)	Column not run	11-Dec-04	18-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
7-T	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
7-T	Pilot Log #	(#)		18-7T	19-7T	20-7T	21-7T	22-7T	23-7T	24-7T
7-T	Lab ID #	(#)		0412287-09	0412440-12	0503367-04	0503550-10	0504465-04	0505150-07	0505423-01
7-T	Turbidity (field)	NTU		16.9	277	192	23.5	58	48.9	259
7-T	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.11	< 0.03	< 0.03
7-T	Phosphorus - total	mg-P/L		< 0.03	0.07	0.11	< 0.03	1.27	0.20	0.23
8-T	Filter Media	(desc.)	AA (14/28)	AA (14/28)	AA (14/28)	AA (14/28)	AA (14/28)	AA (14/28)	AA (14/28)	AA (14/28)
8-T	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
8-T	Flow Started	(date)	Column not run	11-Dec-04	18-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
8-T	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
8-T	Pilot Log #	(#)		18-8T	19-8T	20-8T	21-8T	22-8T	23-8T	24-8T
8-T	Lab ID #	(#)		0412296-12	0412440-15	0503361-04	0503550-04	0504466-04	0505150-09	0505423-06
8-T	Turbidity (field)	NTU		15.2	172	139	30.3	55.2	45.6	169
8-T	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.11	< 0.03	< 0.03
8-T	Phosphorus - total	mg-P/L		< 0.03	0.05	0.13	< 0.03	0.24	< 0.03	0.12
9-T	Filter Media	(desc.)	Superior 30	Superior 30	Superior 30	Superior 30	Superior 30	Superior 30	Superior 30	Superior 30
9-T	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
9-T	Flow Started	(date)	Column not run	11-Dec-04	18-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
9-T	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
9-T	Pilot Log #	(#)		18-9T	19-9T	20-9T	21-9T	22-9T	23-9T	24-9T
9-T	Lab ID #	(#)		0412287-08	0412447-06	0503367-06	0503550-11	0504457-01	0505150-10	0505422-07
9-T	Turbidity (field)	NTU		27.5	197	201	39.3	134	63.2	278
9-T	Phosphorus - dissolved	mg-P/L		< 0.03	0.03	< 0.03	< 0.03	0.21	0.27	< 0.03
9-T	Phosphorus - total	mg-P/L		< 0.03	0.06	0.18	0.04	0.32	0.62	0.46
10-T	Filter Media	(desc.)	Superior 30	Superior 30	Superior 30	Superior 30	Superior 30	Superior 30	Superior 30	Superior 30
10-T	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
10-T	Flow Started	(date)	Column not run	11-Dec-04	18-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
10-T	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
10-T	Pilot Log #	(#)		18-10T	19-10T	20-10T	21-10T	22-10T	23-10T	24-10T
10-T	Lab ID #	(#)		0412296-10	0412440-13	0503361-05	0503550-05	0504466-05	0505150-11	0505422-04
10-T	Turbidity (field)	NTU		28.3	224	213	37.9	94.2	72.3	220
10-T	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.16	0.27	0.27
10-T	Phosphorus - total	mg-P/L		< 0.03	0.06	0.08	0.04	0.24	0.41	0.40

Table B-22 (Continued). 4-Inch Filter Column Interface and 12" Depth Samples

Unit	Parameter	Units	RUN 17A	RUN 18	RUN 19	RUN 20	RUN 21	RUN 22	RUN 23	RUN 24
11-T	Filter Media	(desc.)	Limestone	Limestone	Limestone	Limestone	Limestone	Limestone	Limestone	Limestone
11-T	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
11-T	Flow Started	(date)	Column not run	11-Dec-04	18-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
11-T	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
11-T	Pilot Log #	(#)		18-11T	19-11T	20-11T	21-11T	22-11T	23-11T	24-11T
11-T	Lab ID #	(#)		0412296-09	0412447-10	0503361-13	0503550-12	0504457-02	0505150-12	0505423-03
11-T	Turbidity (field)	NTU		24.4	280	210	35	118	57.3	184
11-T	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.16	0.26	0.28
11-T	Phosphorus - total	mg-P/L		< 0.03	0.08	0.10	0.05	0.47	0.27	0.44
12-T	Filter Media	(desc.)	Limestone	Limestone	Limestone	Limestone	Limestone	Limestone	Limestone	Limestone
12-T	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
12-T	Flow Started	(date)	Column not run	11-Dec-04	18-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
12-T	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
12-T	Pilot Log #	(#)		18-12T	19-12T	20-12T	21-12T	22-12T	23-12T	24-12T
12-T	Lab ID #	(#)		0412296-04	0412440-10	0503361-06	0503550-06	0504466-06	0505150-13	0505423-04
12-T	Turbidity (field)	NTU		29.0	262	193	34.9	64.6	57.5	171
12-T	Phosphorus - dissolved	mg-P/L		< 0.03	0.08	< 0.03	< 0.03	0.18	0.26	0.29
12-T	Phosphorus - total	mg-P/L		< 0.03	0.13	0.06	0.05	0.26	0.73	0.39
13-T	Filter Media	(desc.)	Fe-Mod AA	Fe-Mod AA	Fe-Mod AA	Fe-Mod AA	Fe-Mod AA	Fe-Mod AA	Fe-Mod AA	Fe-Mod AA
13-T	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
13-T	Flow Started	(date)	Column not run	11-Dec-04	18-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
13-T	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
13-T	Pilot Log #	(#)		18-13T	19-13T	20-13T	21-13T	22-13T	23-13T	24-13T
13-T	Lab ID #	(#)		0412287-04	0412440-01	0503361-07	0503550-13	0504457-03	0505150-14	0505422-03
13-T	Turbidity (field)	NTU		1.5	39.1	1.3	10.8	4.12	80.1	237
13-T	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.10	< 0.03	< 0.03
13-T	Phosphorus - total	mg-P/L		< 0.03	< 0.03	0.03	< 0.03	0.19	0.20	0.19
14-T	Filter Media	(desc.)	Fe-Mod AA	Fe-Mod AA	Fe-Mod AA	Fe-Mod AA	Fe-Mod AA	Fe-Mod AA	Fe-Mod AA	Fe-Mod AA
14-T	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
14-T	Flow Started	(date)	Column not run	11-Dec-04	18-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
14-T	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
14-T	Pilot Log #	(#)		18-14T	19-14T	20-14T	21-14T	22-14T	23-14T	24-14T
14-T	Lab ID #	(#)		0412296-05	0412440-10	0503361-14	0503540-07	0504466-07	0505150-15	0505422-01
14-T	Turbidity (field)	NTU		1.3	20.0	0.7	2.3	19.3	79.5	246
14-T	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.10	< 0.03	< 0.03
14-T	Phosphorus - total	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.11	0.20	0.19
15-T	Filter Media	(desc.)	GFH	GFH	GFH	GFH	GFH	GFH	GFH	GFH
15-T	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
15-T	Flow Started	(date)	Column not run	11-Dec-04	18-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
15-T	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
15-T	Pilot Log #	(#)		18-15T	19-15T	20-15T	21-15T	22-15T	23-15T	24-15T
15-T	Lab ID #	(#)		0412287-07	0412440-06	0503361-08	0503550-15	0504457-04	0505150-16	0505423-12
15-T	Turbidity (field)	NTU		6.2	2.2	64.8	17.3	32.6	49.5	9.19
15-T	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	0.03	< 0.03	0.08	< 0.03	< 0.03
15-T	Phosphorus - total	mg-P/L		< 0.03	< 0.03	0.10	< 0.03	0.14	< 0.03	< 0.03

Table B-22 (Continued). 4-Inch Filter Column Interface and 12" Depth Samples

Unit	Parameter	Units	RUN 17A	RUN 18	RUN 19	RUN 20	RUN 21	RUN 22	RUN 23	RUN 24
16-T	Filter Media	(desc.)	GFH	GFH	GFH	GFH	GFH	GFH	GFH	GFH
16-T	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
16-T	Flow Started	(date)	Column not run	11-Dec-04	18-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
16-T	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
16-T	Pilot Log #	(#)		18-16T	19-16T	20-16T	21-16T	22-16T	23-16T	24-16T
16-T	Lab ID #	(#)		0412287-05	0412440-05	0503361-15	0503540-08	0504466-08	0505150-17	0505422-08
16-T	Turbidity (field)	NTU		3.6	6.5	137	25.2	258	58.7	65.3
16-T	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.10	< 0.03	< 0.03
16-T	Phosphorus - total	mg-P/L		< 0.03	< 0.03	0.06	< 0.03	0.11	< 0.03	< 0.03
17-T	Filter Media	(desc.)	Bayoxide E33	Bayoxide E33	Bayoxide E33	Bayoxide E33	Bayoxide E33	Bayoxide E33	Bayoxide E33	Bayoxide E33
17-T	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
17-T	Flow Started	(date)	Column not run	11-Dec-04	18-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
17-T	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
17-T	Pilot Log #	(#)		18-17T	19-17T	20-17T	21-17T	22-17T	23-17T	24-17T
17-T	Lab ID #	(#)		0412296-06	0412447-05	0503361-09	0503550-16	0504456-01	0505150-18	0505423-02
17-T	Turbidity (field)	NTU		12.0	213	159	28.2	40	40.2	117
17-T	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	0.03	< 0.03	0.07	< 0.03	< 0.03
17-T	Phosphorus - total	mg-P/L		< 0.03	0.15	0.12	< 0.03	0.20	< 0.03	0.11
18-T	Filter Media	(desc.)	Bayoxide E33	Bayoxide E33	Bayoxide E33	Bayoxide E33	Bayoxide E33	Bayoxide E33	Bayoxide E33	Bayoxide E33
18-T	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
18-T	Flow Started	(date)	Column not run	11-Dec-04	18-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
18-T	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
18-T	Pilot Log #	(#)		18-18T	19-18T	20-18T	21-18T	22-18T	23-18T	24-18T
18-T	Lab ID #	(#)		0412287-10	0412439-01	0503361-16	0503540-09	0504466-09	0505154-09	0505423-07
18-T	Turbidity (field)	NTU		8.4	159.0	190	25.7	60.2	47.7	223
18-T	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.11	< 0.03	0.24
18-T	Phosphorus - total	mg-P/L		< 0.03	0.04	0.06	0.03	0.55	< 0.03	0.26
21-T	Filter Media	(desc.)	Eq blk	Eq blk	Eq blk	Eq blk	Eq blk	Eq blk	Eq blk	Eq blk
	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
Eq Blk	Flow Started	(date)	Column not run	11-Dec-04	18-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
21-T	Pilot Log #	(#)		18-21T	19-21T	20-21T	21-21T	22-21T	23-21T	24-21T
21-T	Lab ID #	(#)		0412296-07	0412447-01	0503361-18	0503545-04	0504455-01	0505154-03	0505421-01
21-T	Turbidity (field)	NTU		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
21-T	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
21-T	Phosphorus - total	mg-P/L		< 0.03	< 0.03	0.03	< 0.03	< 0.03	< 0.03	< 0.03
22-T	Filter Media	(desc.)	Btl Blk	Btl Blk	Btl Blk	Btl Blk	Btl Blk	Btl Blk	Btl Blk	Btl Blk
	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
Btl Blk	Flow Started	(date)	Column not run	11-Dec-04	18-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
22-T	Pilot Log #	(#)		18-22T	19-22T	20-22T	21-22T	22-22T	23-22T	24-22T
22-T	Lab ID #	(#)		0412296-13	0412447-03	0503405-01	0503545-02	0504455-03	0505154-01	0505422-06
22-T	Turbidity (field)	NTU		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
22-T	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
22-T	Phosphorus - total	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03

Table B-22 (Continued). 4-Inch Filter Column Interface and 12" Depth Samples

Unit	Parameter	Units	RUN 17A	RUN 18	RUN 19	RUN 20	RUN 21	RUN 22	RUN 23	RUN 24
23-T	Filter Media	(desc.)	Dup	Dup of 10T	Dup of 5T	Dup of 7T	Dup of 13T	Dup of 7T	Dup of 7T	Dup of 14T
	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
Dup	Flow Started	(date)	Column not run	11-Dec-04	18-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
23-T	Pilot Log #	(#)		18-10TD	19-23T	20-23T	21-23T	22-23T	23-23T	24-23T
23-T	Lab ID #	(#)		0412296-11	0412440-03	0503367-05	0503550-14	0504456-04	0505150-08	0505422-02
23-T	Turbidity (field)	NTU		29.1	172.0	195	11.1	58.2	50.0	244
23-T	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.17	< 0.03	< 0.03
23-T	Phosphorus - total	mg-P/L		< 0.03	0.04	0.18	< 0.03	1.32	0.25	0.22
F-1	Composite of Columns	-		Cols 1-6	Cols 1-6	Cols 1-6	Cols 1-6	Cols 1-6	Cols 1-6	Cols 1-6
F-1	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
F-1	Flow Started	(date)	Column not run	11-Dec-04	18-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
F-1	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
F-1	Pilot Log #	(#)		18-1F	19-1F	20-F1	21-F1	22-F1	23-F1	24-F1
F-1	Lab ID #	(#)		0412292-02	0412440-07	0503361-17	0503550-18	0504456-02	0505154-05	0505422-09
F-1	Turbidity (field)	NTU		35.7	2,142	1464	46.1	1726	189	1213
F-1	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	0.08	< 0.03	0.11	0.24	0.17
F-1	Phosphorus - total	mg-P/L		< 0.03	< 0.03	0.93	0.07	0.82	0.33	0.71
F-2	Composite of Columns	-		Cols 7-12	Cols 7-12	Cols 7-12	Cols 7-12	Cols 7-12	Cols 7-12	Cols 7-12
F-2	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
F-2	Flow Started	(date)	Column not run	11-Dec-04	18-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
F-2	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
F-2	Pilot Log #	(#)		18-2F	19-2F	20-F2	21-F2	22-F2	23-F2	24-F2
F-2	Lab ID #	(#)		0412287-06	0412440-08	0503361-11	0503540-11	0504456-03	0505154-07	0505422-10
F-2	Turbidity (field)	NTU		34.1	441	403	53.8	487	75.4	346
F-2	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	0.17	0.23	0.27
F-2	Phosphorus - total	mg-P/L		< 0.03	0.14	0.25	0.06	0.43	0.26	0.61
F-3	Composite of Columns	-		Cols 13-18	Cols 13-18	Cols 13-18	Cols 13-18	Cols 13-18	Cols 13-18	Cols 13-18
F-3	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
F-3	Flow Started	(date)	Column not run	11-Dec-04	18-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
F-3	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
F-3	Pilot Log #	(#)		18-3F	19-3F	20-F3	21-F3	22-F3	23-F3	24-F3
F-3	Lab ID #	(#)		0412292-01	0412440-09	0503361-10	0503540-10	0504466-10	0505154-08	0505422-12
F-3	Turbidity (field)	NTU		26.5	324	1121	139	1523	190	935
F-3	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	0.06	< 0.03	0.18	0.23	0.24
F-3	Phosphorus - total	mg-P/L		< 0.03	0.09	0.82	0.18	2.68	0.30	0.80
F-4	Composite of Columns	-		Eq Blk	Eq Blk	Eq Blk	Eq Blk	Eq Blk	Eq Blk	Eq Blk
	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
Eq Blk	Flow Started	(date)	Column not run	11-Dec-04	18-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
F-4	Pilot Log #	(#)		18-4F	19-4F	20-F4	21-F4	22-F4	23-F4	24-F4
F-4	Lab ID #	(#)		0412296-08	0412447-02	0503405-03	0503545-03	0504455-02	0505154-04	0505421-02
F-4	Turbidity (field)	NTU		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
F-4	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
F-4	Phosphorus - total	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03

Table B-22 (Continued). 4-Inch Filter Column Interface and 12" Depth Samples

Unit	Parameter	Units	RUN 17A	RUN 18	RUN 19	RUN 20	RUN 21	RUN 22	RUN 23	RUN 24
F-5	Composite of Columns	-		Btl Blk	Btl Blk	Btl Blk	Btl Blk	Btl Blk	Btl Blk	No Sample
	Influent Collected	(date)		9-Dec-04	9-Dec-04	11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	
Btl Blk	Flow Started	(date)	Column not run	11-Dec-04	18-Dec-04	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	
	Date Sampled	(date)		13-Dec-04	21-Dec-04	15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	
F-5	Pilot Log #	(#)		18-5F	19-5F	20-F5	21-F5	22-F5	23-F5	
F-5	Lab ID #	(#)		0412296-14	0412447-04	0503405-02	0503545-01	0504455-04	0505154-02	
F-5	Turbidity (field)	NTU		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
F-5	Phosphorus - dissolved	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	
F-5	Phosphorus - total	mg-P/L		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	
F-6	Composite of Columns	-	Column not run	No Sample	No Sample	Dup of F2	Dup of F1	No Sample	Dup of F1	Dup of F2
	Influent Collected	(date)				11-Mar-05	19-Mar-05		28-Apr-05	13-May-05
Other	Flow Started	(date)				12-Mar-05	20-Mar-05		30-Apr-05	14-May-05
	Date Sampled	(date)				15-Mar-05	23-Mar-05		3-May-05	17-May-05
F-6	Pilot Log #	(#)				20-F6	21-F6		23-F6	24-F6
F-6	Lab ID #	(#)				0503361-12	0503550-17		0505154-06	0505422-11
F-6	Turbidity (field)	NTU				400	45.8		190	351
F-6	Phosphorus - dissolved	mg-P/L				< 0.03	< 0.03		0.26	0.26
F-6	Phosphorus - total	mg-P/L				0.25	0.05		0.37	0.55

Table B-23. Limestone Polish, 4-Inch Filter Column Data

Limestone Polishing Column (following Column 6, DD-2 AA, 28x48)										
Unit	**Parameter**	**Units**	**RUN 17A**	**RUN 18**	**RUN 19**	**RUN 20**	**RUN 21**	**RUN 22**	**RUN 23**	**RUN 24**
MC-E	Filter Media	(desc.)	12" Limestone	12" Limestone	12" Limestone	12" Limestone	12" Limestone	12" Limestone	12" Limestone	12" Limestone
MC-E	Sample		Effluent	Effluent	Effluent	Effluent	Effluent	Effluent	Effluent	Effluent
MC-E	Influent Collected	(date)				11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
MC-E	Flow Started	(date)	Column not run	Column not run	Column not run	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
MC-E	Date Sampled	(date)				15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
MC-E	Pilot Log #	(#)				20-MC6E	21-MC6E	22-MC6E	23-MC6E	24-MC6E
MC-E	Lab ID #	(#)				0503352-01	0503533-01	0504462-01	0505157-01	0505411-01
MC-E	pH (field)	S.U.				8.6	8.3	8.4	8.7	8.4
MC-E	EC (field)	µS				3,010	634	3,642	619	449
MC-E	Turbidity (field)	NTU				8.6	15.9	0.9	25.5	0.9
MC-E	Temperature (field)	°C				9.3	10.8	12.6	12.6	12.8
MC-E										
MC-E	Aluminum - dissolved	µg/L				40	52	43	173	37
MC-D6	Filter Media	(desc.)	12" Limestone	12" Limestone	12" Limestone	12" Limestone	12" Limestone	12" Limestone	12" Limestone	12" Limestone
MC-D6	Sample		6" Depth	6" Depth	6" Depth	6" Depth	6" Depth	6" Depth	6" Depth	6" Depth
MC-D6	Influent Collected	(date)				11-Mar-05	19-Mar-05	22-Apr-05	28-Apr-05	13-May-05
MC-D6	Flow Started	(date)	Column not run	Column not run	Column not run	12-Mar-05	20-Mar-05	23-Apr-05	30-Apr-05	14-May-05
MC-D6	Date Sampled	(date)				15-Mar-05	23-Mar-05	26-Apr-05	3-May-05	17-May-05
MC-D6	Pilot Log #	(#)				20-MCD6	21-MCD6	22-MCD6	23-MCD6	24-MCD6
MC-D6	Lab ID #	(#)				0503346-01	0503560-01	0504463-01	0505158-01	0505412-01
MC-D6	pH (field)	S.U.				Not Measured	Not Measured	Not Measured	Not Measured	Not Measured
MC-D6	EC (field)	µS				Not Measured	Not Measured	Not Measured	Not Measured	Not Measured
MC-D6	Turbidity (field)	NTU				Not Measured	Not Measured	Not Measured	Not Measured	Not Measured
MC-D6	Temperature (field)	°C				Not Measured	Not Measured	Not Measured	Not Measured	Not Measured
MC-D6										
MC-D6	Aluminum - dissolved	µg/L				47	49	48	138	47

Appendix C

4-Inch Extended Run Filter Columns - Graphs

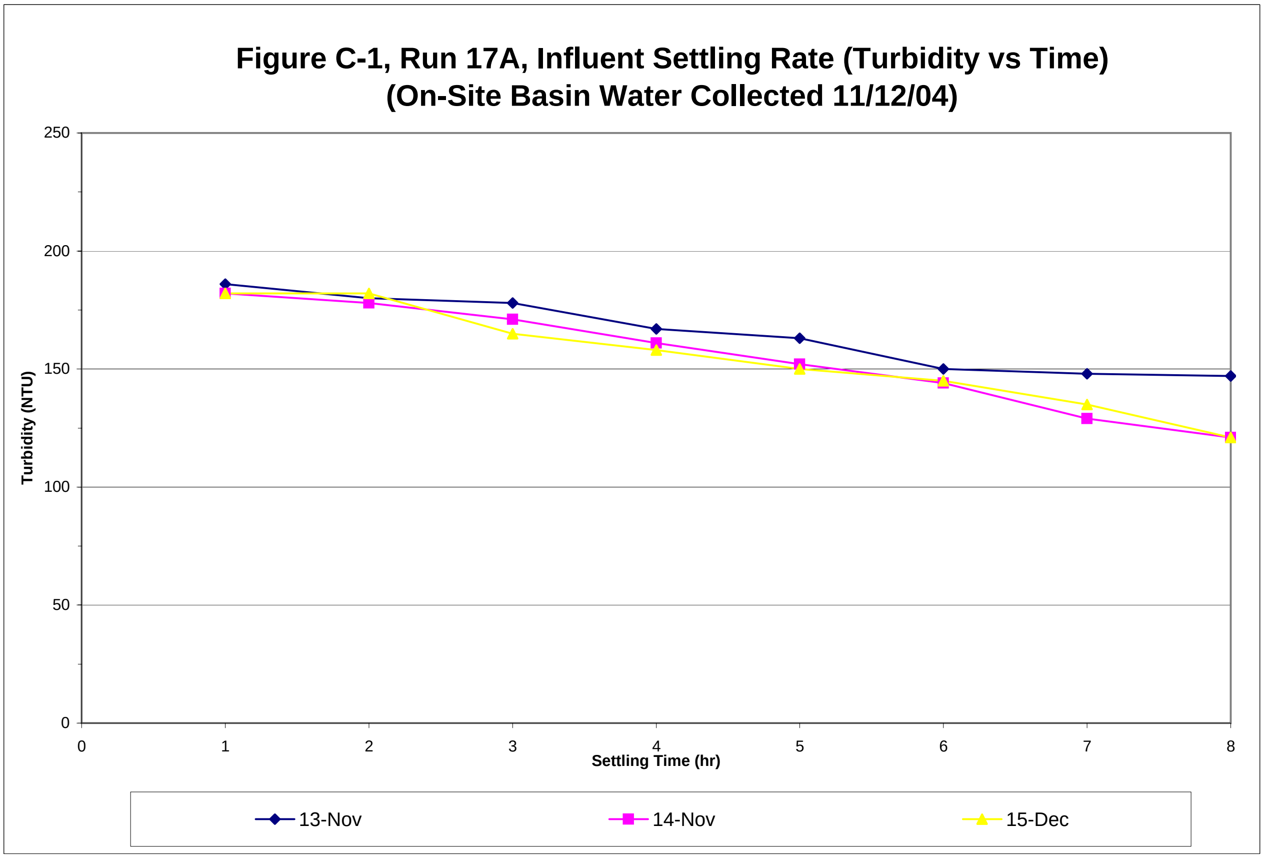


Figure C-1, Run 17A, Influent Settling Rate (Turbidity vs Time)
(On-Site Basin Water Collected 11/12/04)
Turbidity (NTU)
250
200
150
100
50
0
0
1
2
3
4
5
6
7
8
Settling Time (hr)
13-Nov
14-Nov
15-Dec

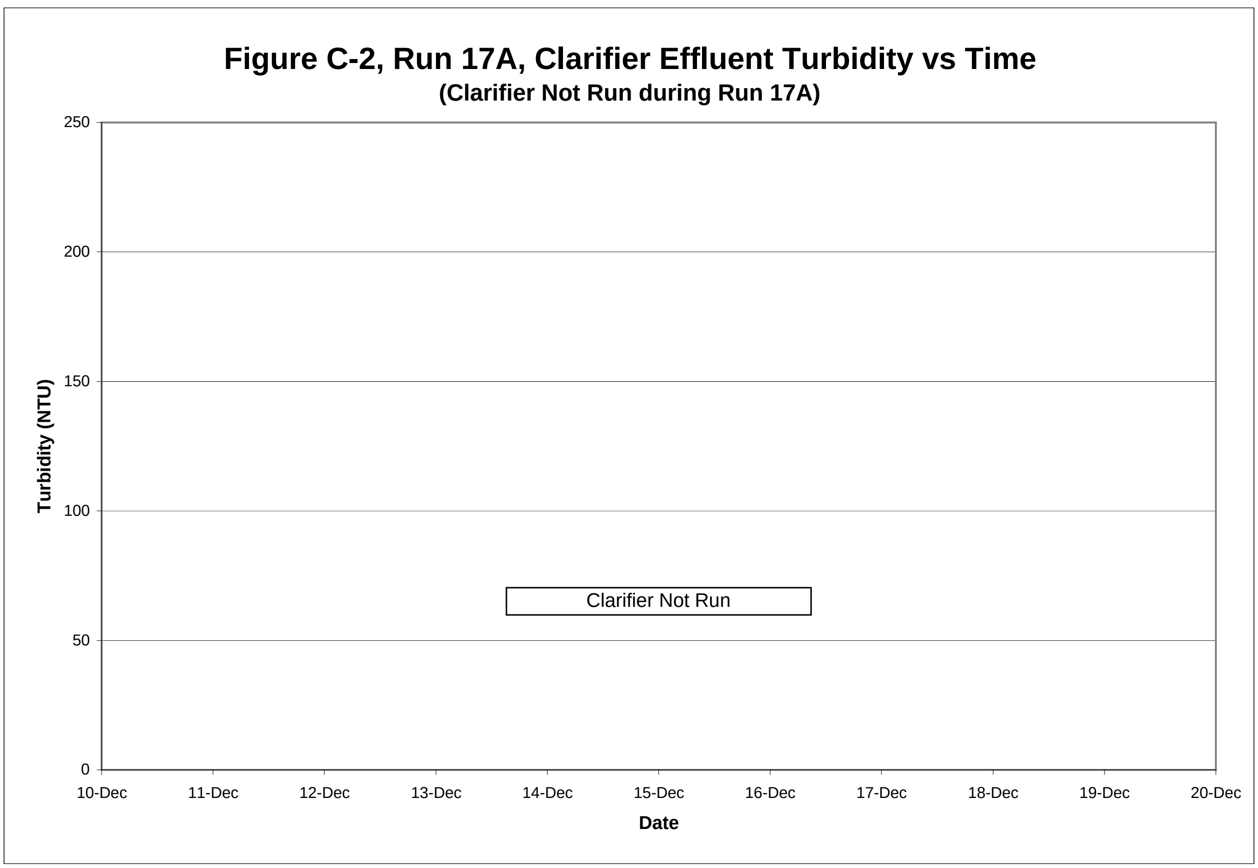


Figure C-2, Run 17A, Clarifier Effluent Turbidity vs Time
(Clarifier Not Run during Run 17A)
Turbidity (NTU)
250
200
150
100
50
0
Clarifier Not Run
10-Dec
11-Dec
12-Dec
13-Dec
14-Dec
15-Dec
16-Dec
17-Dec
18-Dec
19-Dec
20-Dec
Date

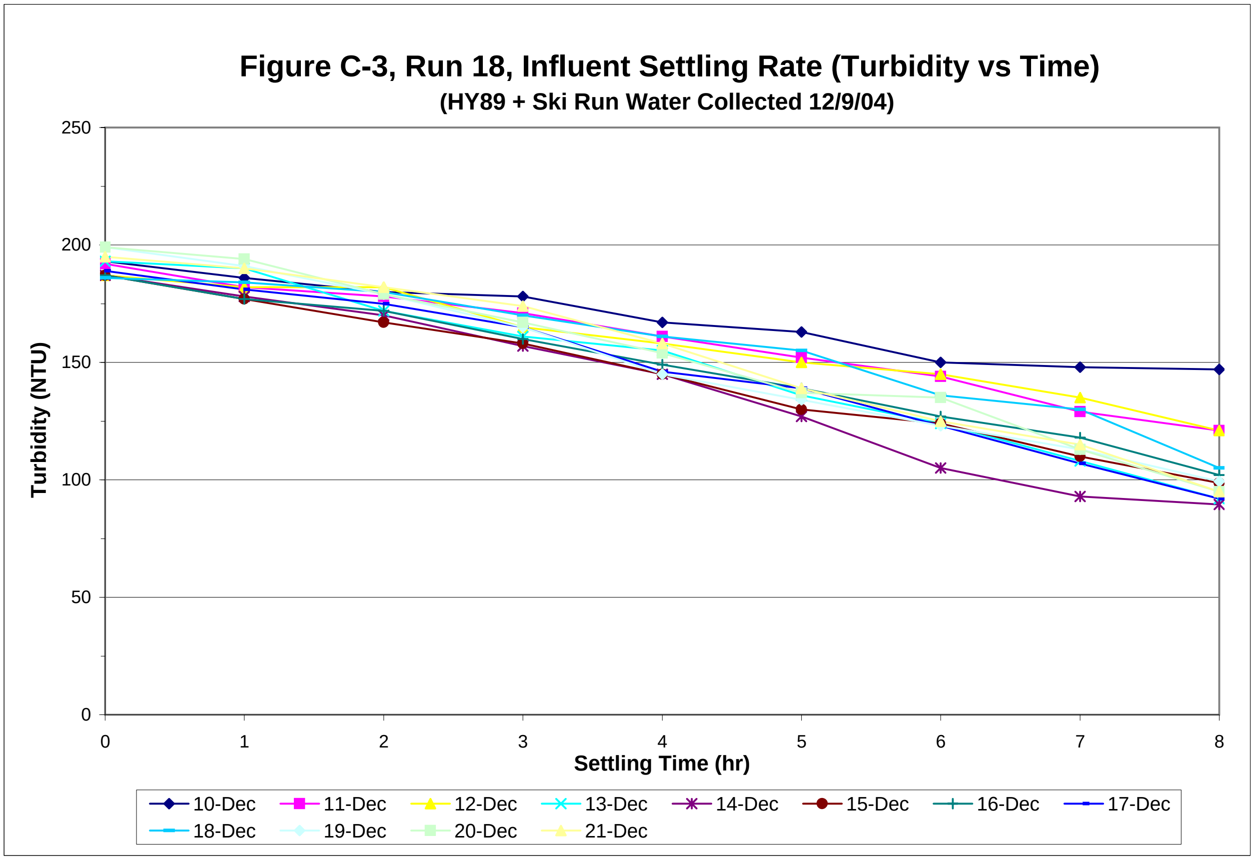


Figure C-3, Run 18, Influent Settling Rate (Turbidity vs Time)
(HY89 + Ski Run Water Collected 12/9/04)
Turbidity (NTU)
250
200
150
100
50
0
0
1
2
3
4
5
6
7
8
Settling Time (hr)
10-Dec
11-Dec
12-Dec
13-Dec
14-Dec
15-Dec
16-Dec
17-Dec
18-Dec
19-Dec
20-Dec
21-Dec

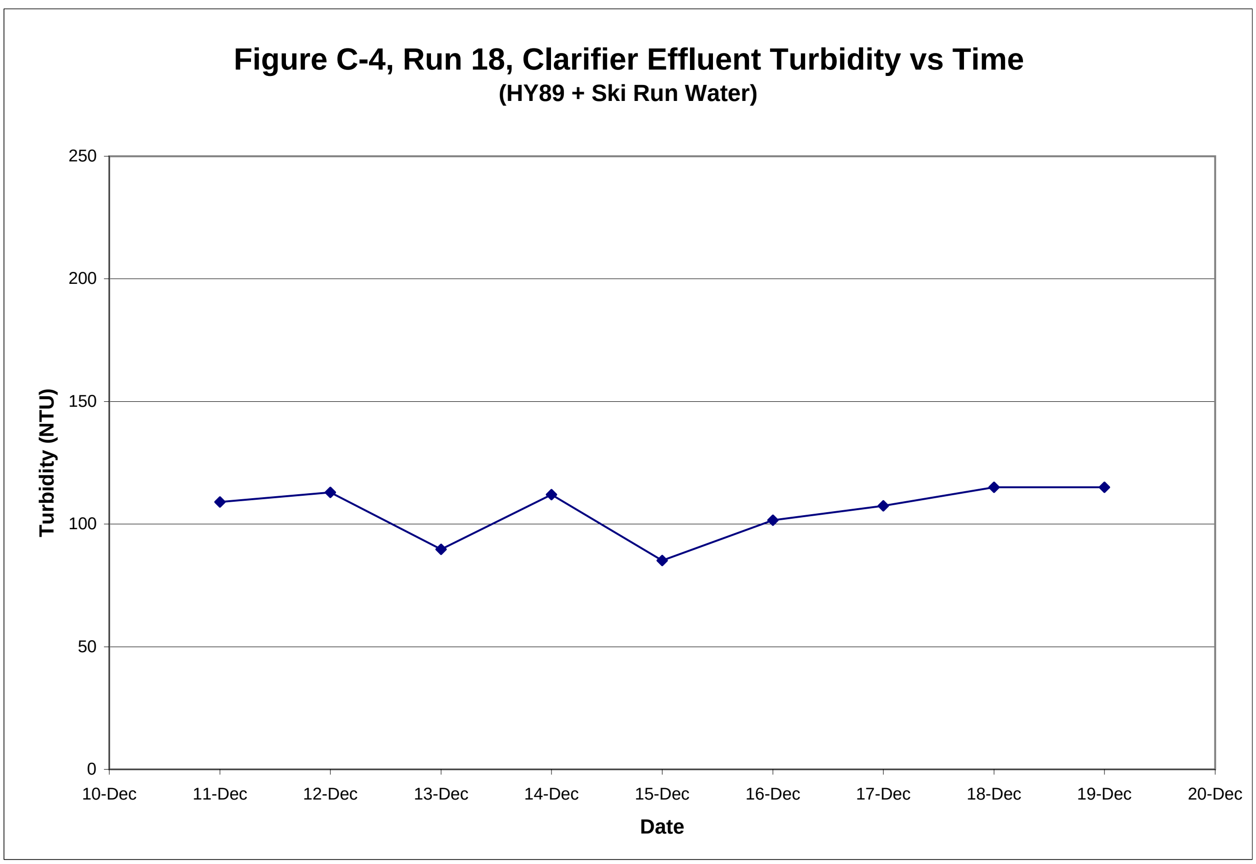


Figure C-4, Run 18, Clarifier Effluent Turbidity vs Time
(HY89 + Ski Run Water)
Turbidity (NTU)
250
200
150
100
50
0
10-Dec
11-Dec
12-Dec
13-Dec
14-Dec
15-Dec
16-Dec
17-Dec
18-Dec
19-Dec
20-Dec
Date

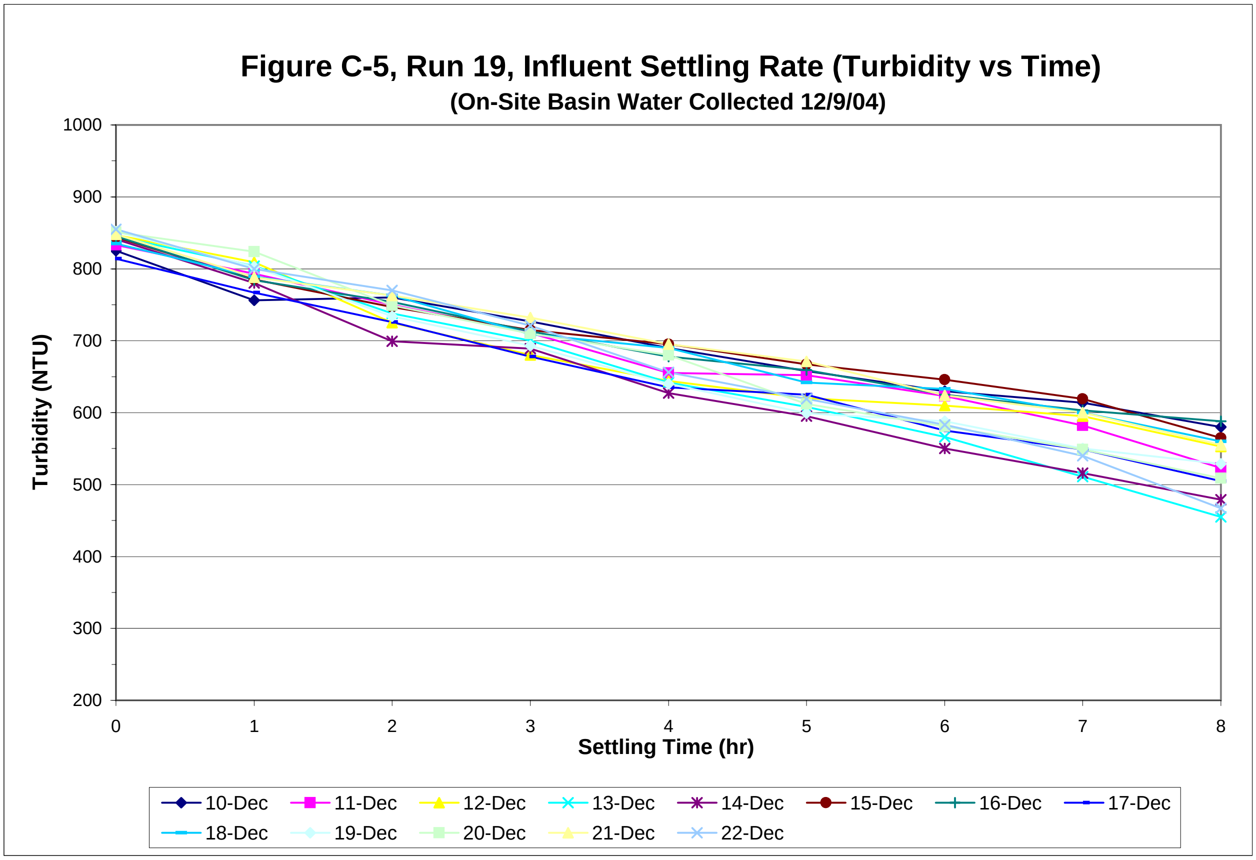


Figure C-5, Run 19, Influent Settling Rate (Turbidity vs Time)
(On-Site Basin Water Collected 12/9/04)
1000
900
800
700
600
500
400
300
200
Turbidity (NTU)
0
1
2
3
4
5
6
7
8
Settling Time (hr)
10-Dec
11-Dec
12-Dec
13-Dec
14-Dec
15-Dec
16-Dec
17-Dec
18-Dec
19-Dec
20-Dec
21-Dec
22-Dec

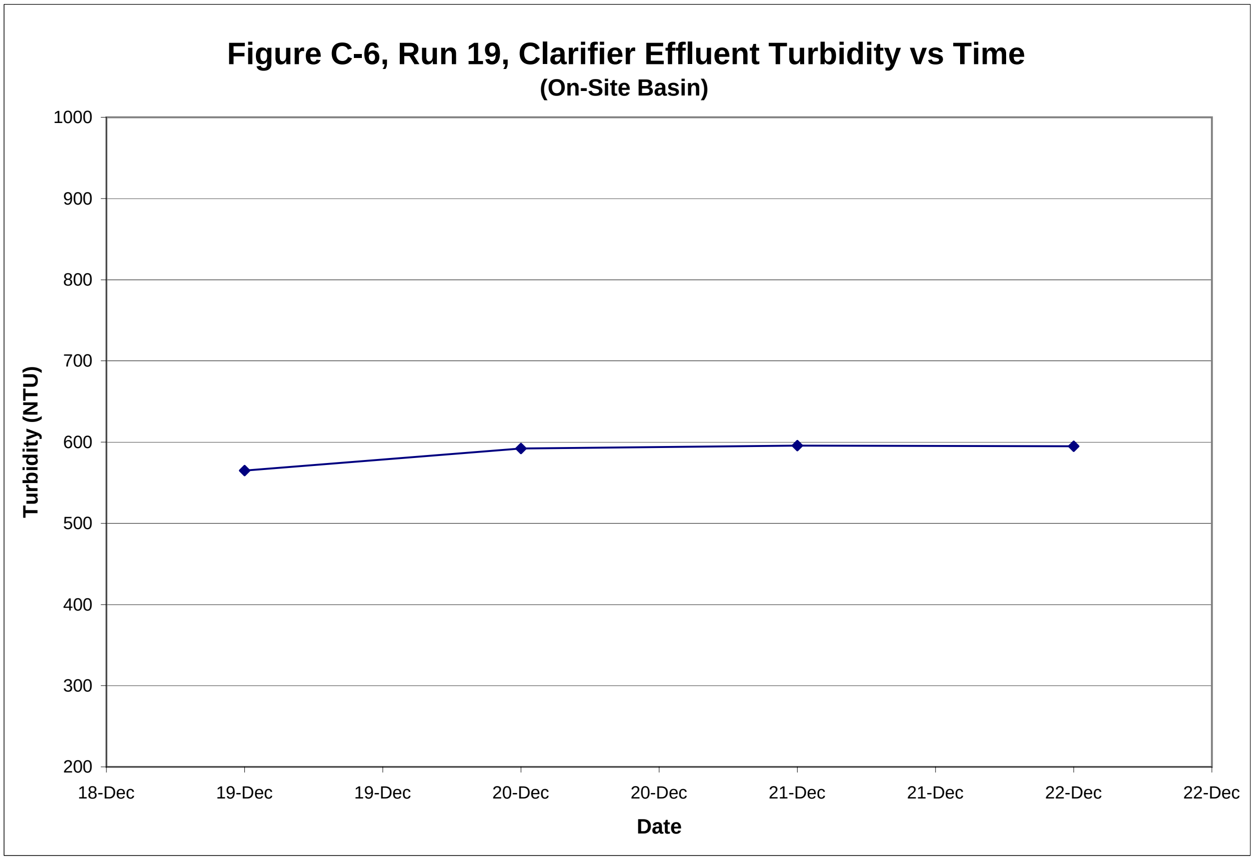


Figure C-6, Run 19, Clarifier Effluent Turbidity vs Time
(On-Site Basin)
1000
900
800
700
600
500
400
300
200
Turbidity (NTU)
18-Dec
19-Dec
19-Dec
20-Dec
20-Dec
21-Dec
21-Dec
22-Dec
22-Dec
Date

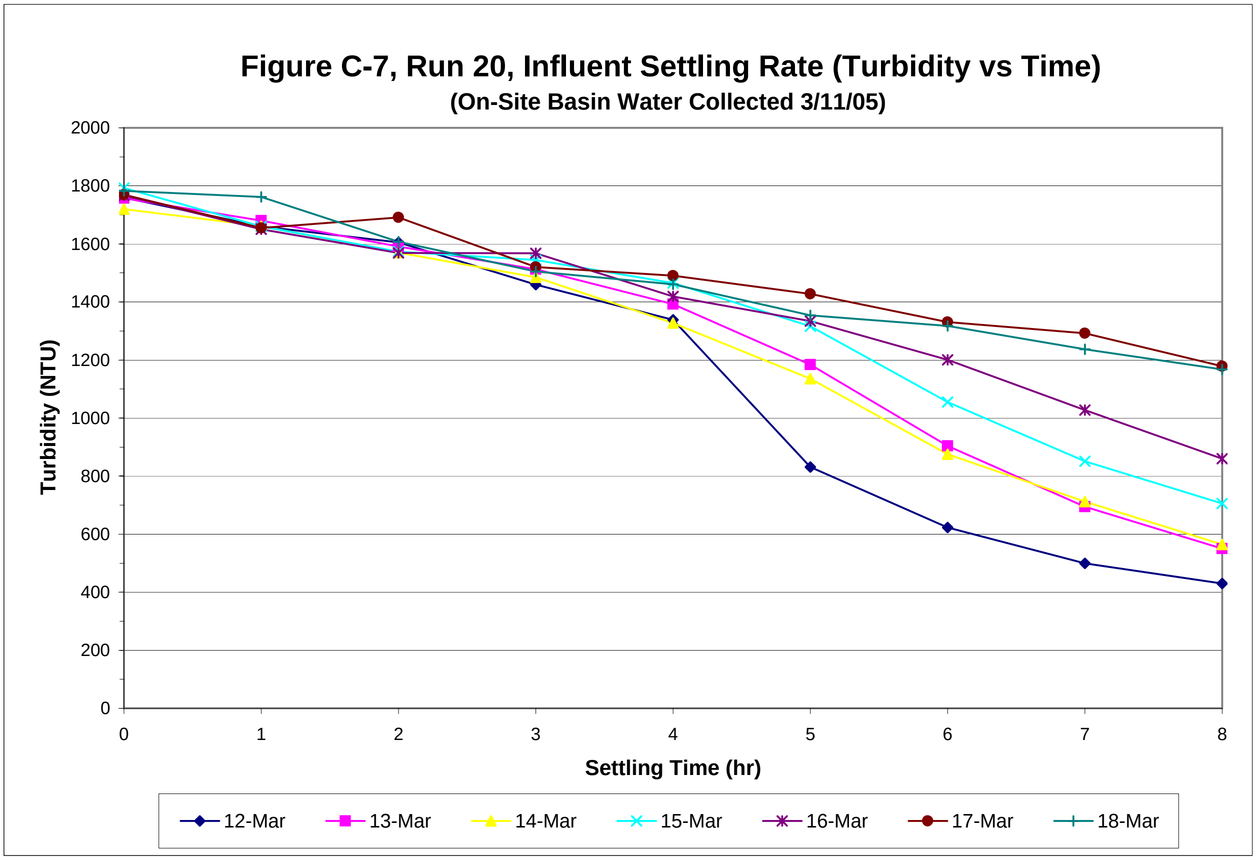


Figure C-7, Run 20, Influent Settling Rate (Turbidity vs Time)
(On-Site Basin Water Collected 3/11/05)
Turbidity (NTU)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0
1
2
3
4
5
6
7
8
Settling Time (hr)
12-Mar
13-Mar
14-Mar
15-Mar
16-Mar
17-Mar
18-Mar

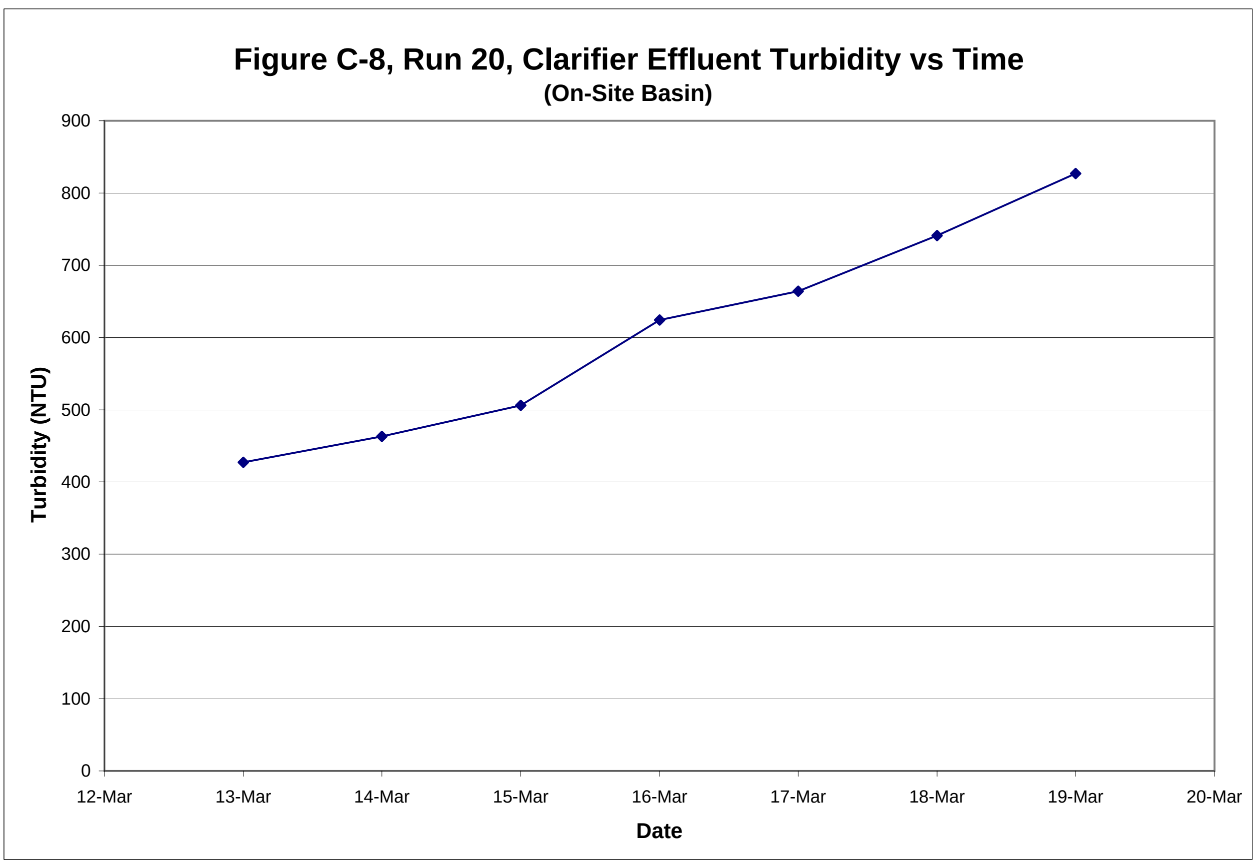


Figure C-8, Run 20, Clarifier Effluent Turbidity vs Time
(On-Site Basin)
Turbidity (NTU)
900
800
700
600
500
400
300
200
100
0
12-Mar
13-Mar
14-Mar
15-Mar
16-Mar
17-Mar
18-Mar
19-Mar
20-Mar
Date

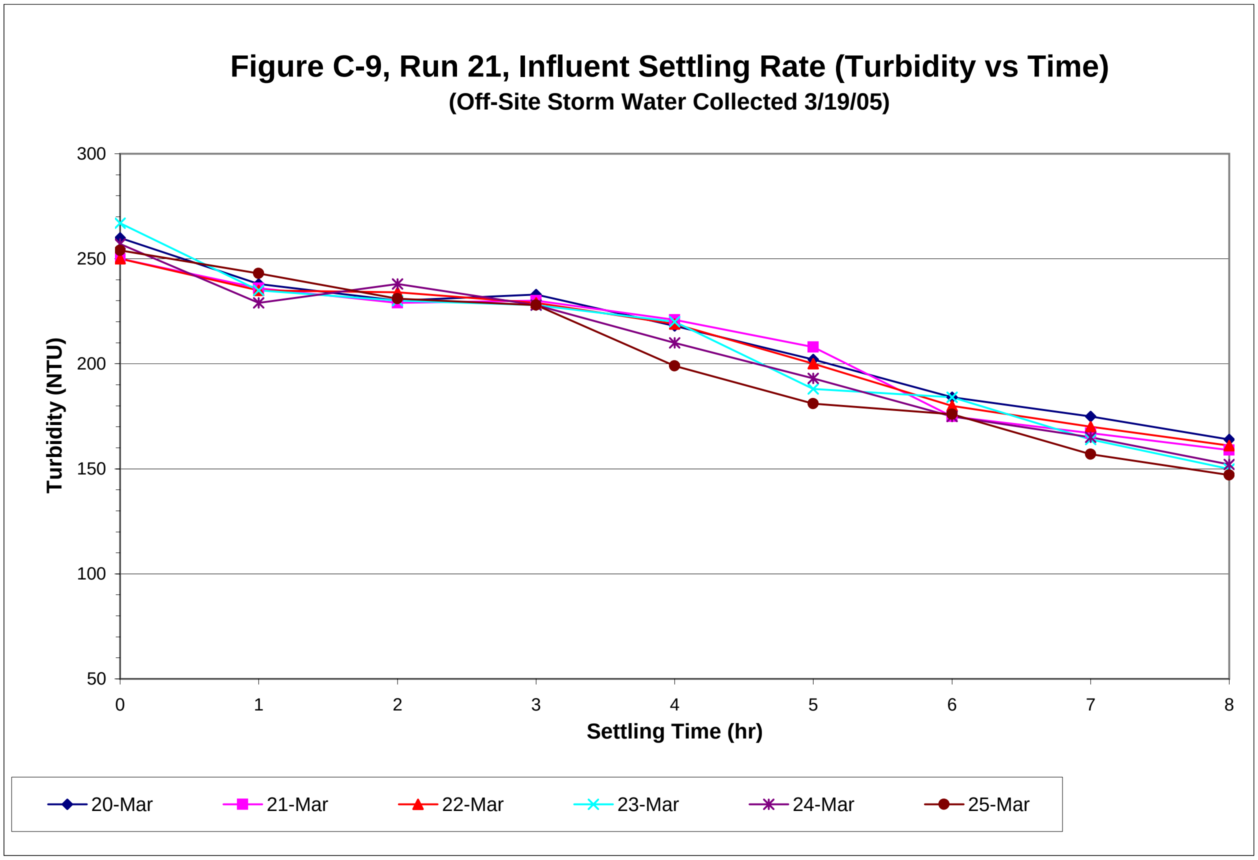


Figure C-9, Run 21, Influent Settling Rate (Turbidity vs Time)
(Off-Site Storm Water Collected 3/19/05)
Turbidity (NTU)
300
250
200
150
100
50
0
1
2
3
4
5
6
7
8
Settling Time (hr)
20-Mar
21-Mar
22-Mar
23-Mar
24-Mar
25-Mar

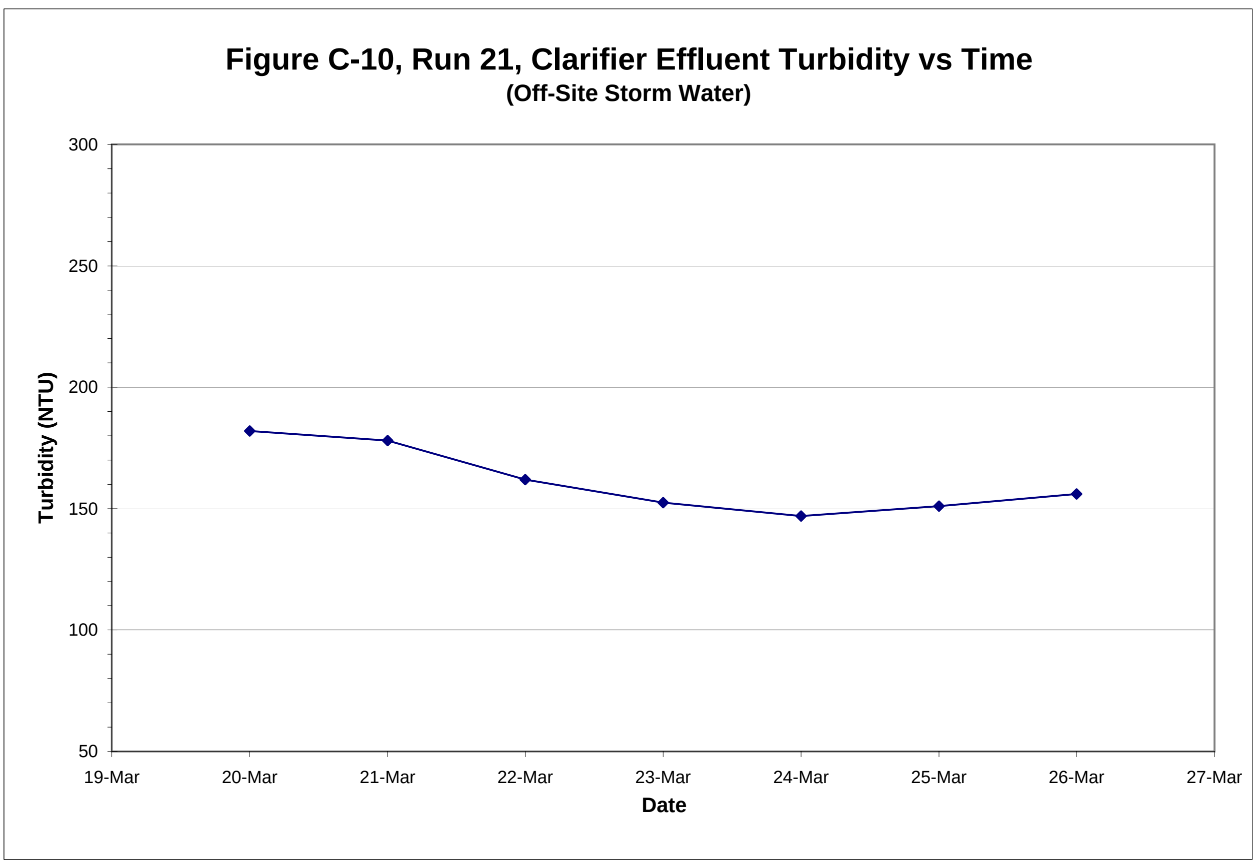


Figure C-10, Run 21, Clarifier Effluent Turbidity vs Time
(Off-Site Storm Water)
Turbidity (NTU)
300
250
200
150
100
50
19-Mar
20-Mar
21-Mar
22-Mar
23-Mar
24-Mar
25-Mar
26-Mar
27-Mar
Date

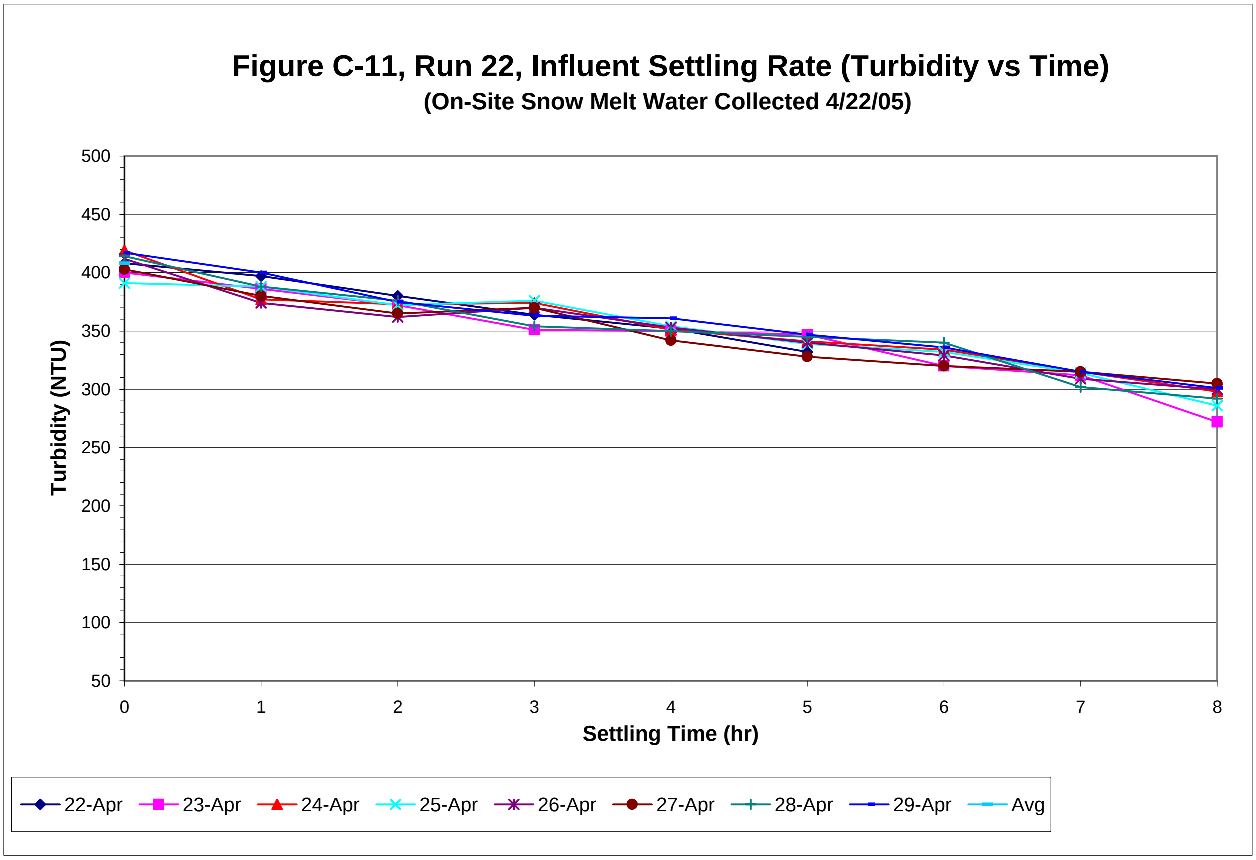


Figure C-11, Run 22, Influent Settling Rate (Turbidity vs Time)
(On-Site Snow Melt Water Collected 4/22/05)
Turbidity (NTU)
500
450
400
350
300
250
200
150
100
50
0
1
2
3
4
5
6
7
8
Settling Time (hr)
22-Apr
23-Apr
24-Apr
25-Apr
26-Apr
27-Apr
28-Apr
29-Apr
Avg

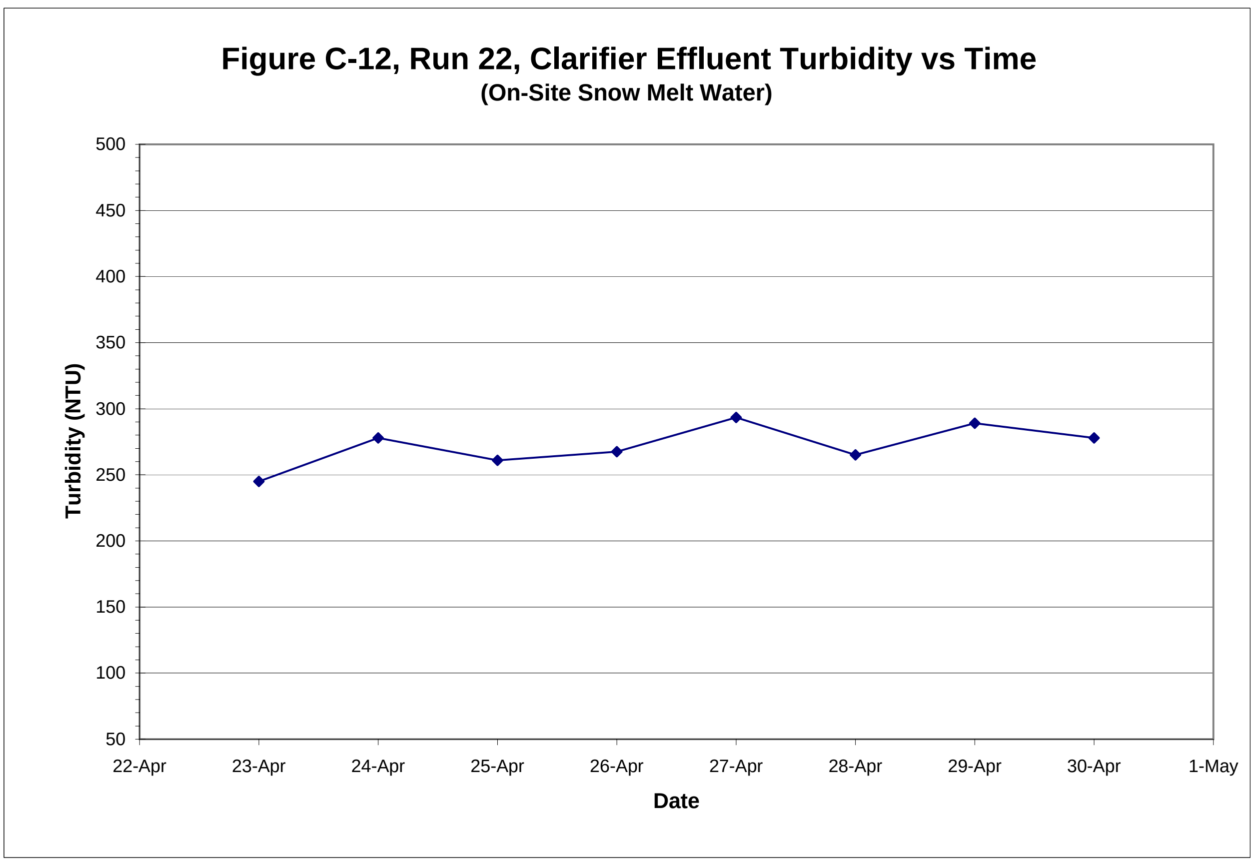


Figure C-12, Run 22, Clarifier Effluent Turbidity vs Time
(On-Site Snow Melt Water)
Turbidity (NTU)
500
450
400
350
300
250
200
150
100
50
22-Apr
23-Apr
24-Apr
25-Apr
26-Apr
27-Apr
28-Apr
29-Apr
30-Apr
1-May
Date

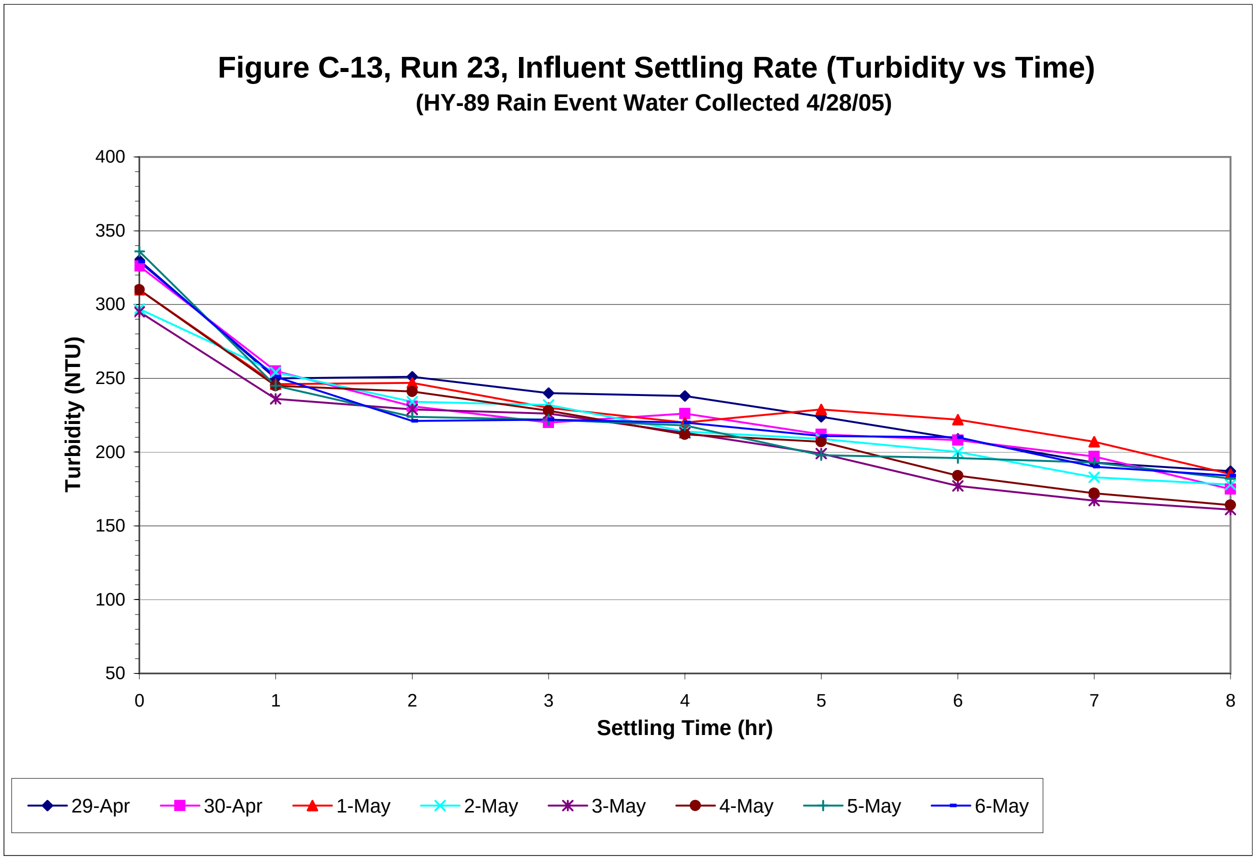


Figure C-13, Run 23, Influent Settling Rate (Turbidity vs Time)
(HY-89 Rain Event Water Collected 4/28/05)
400
350
300
250
200
150
100
50
0
1
2
3
4
5
6
7
8
Turbidity (NTU)
Settling Time (hr)
29-Apr
30-Apr
1-May
2-May
3-May
4-May
5-May
6-May

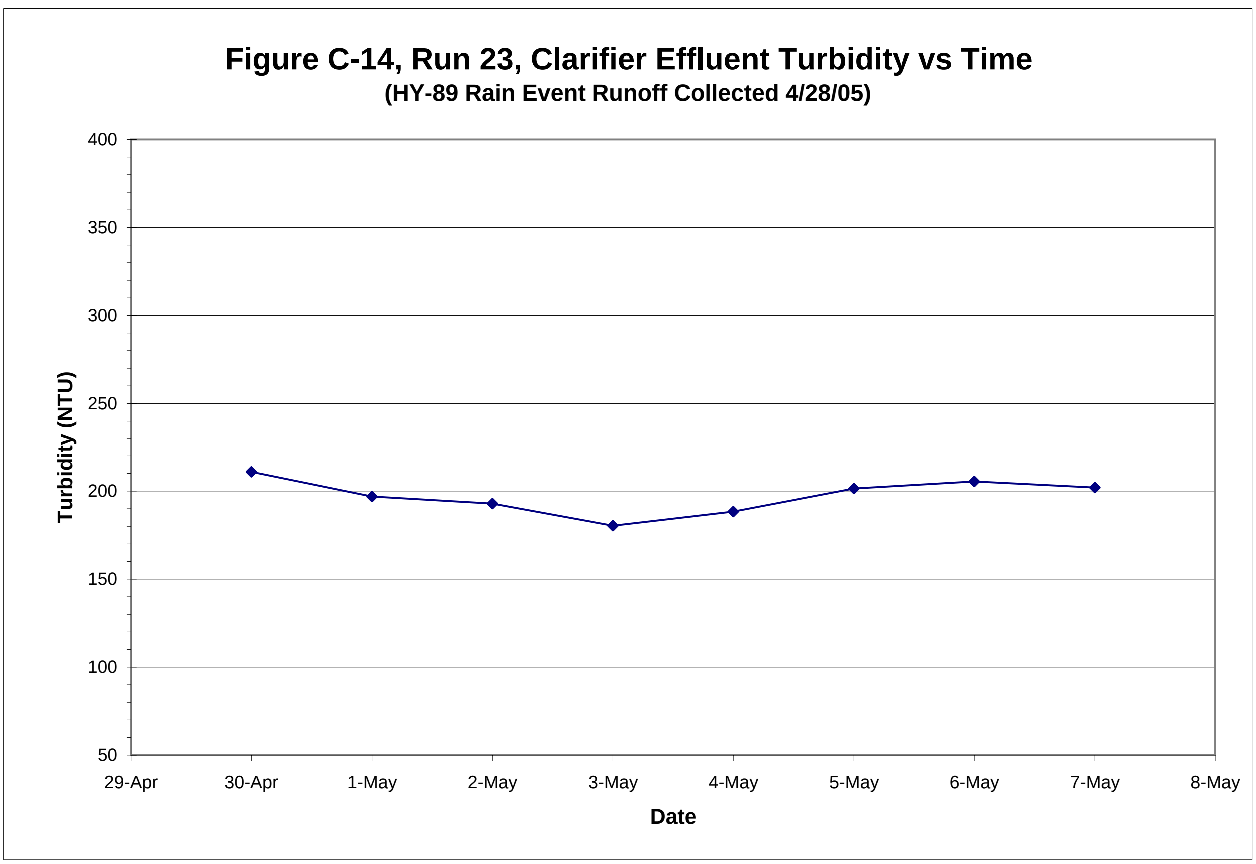


Figure C-14, Run 23, Clarifier Effluent Turbidity vs Time
(HY-89 Rain Event Runoff Collected 4/28/05)
400
350
300
250
200
150
100
50
29-Apr
30-Apr
1-May
2-May
3-May
4-May
5-May
6-May
7-May
8-May
Turbidity (NTU)
Date

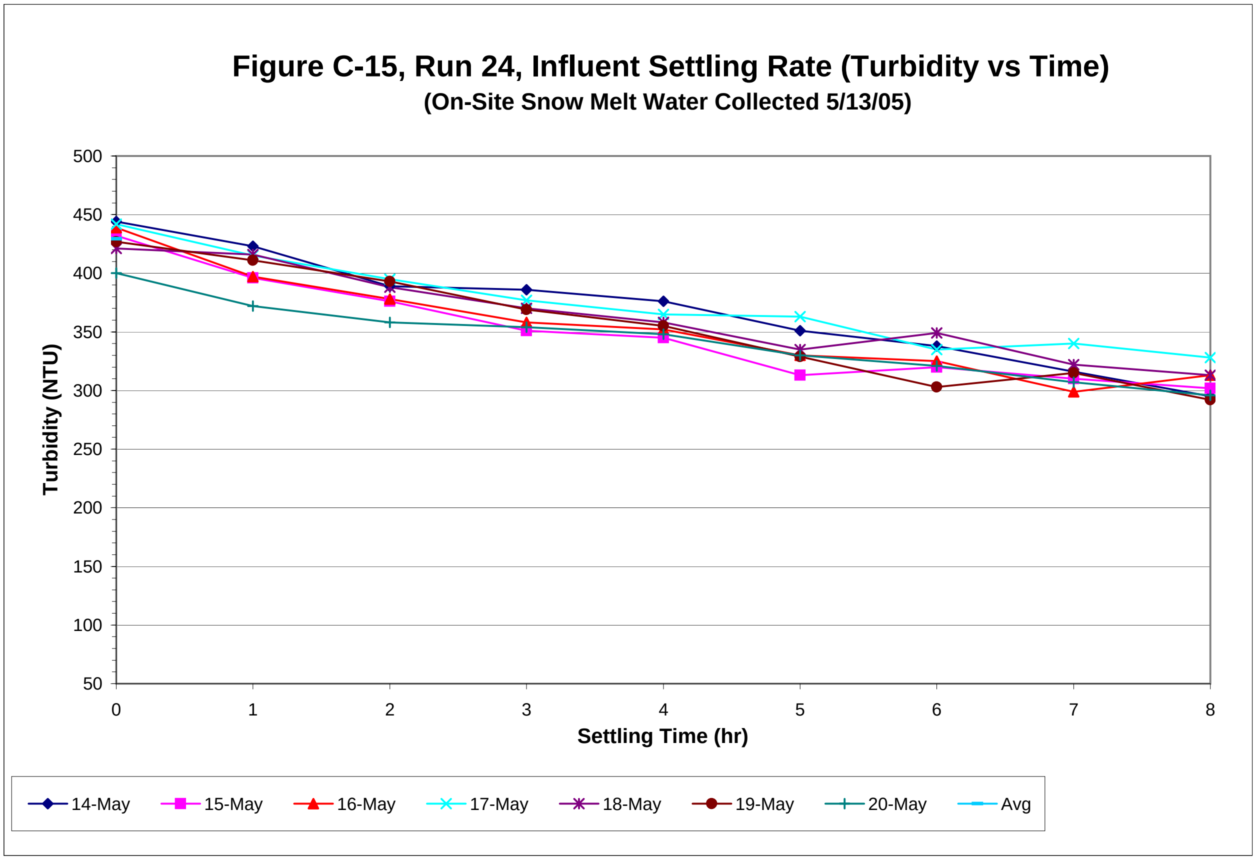


Figure C-15, Run 24, Influent Settling Rate (Turbidity vs Time)
(On-Site Snow Melt Water Collected 5/13/05)
Turbidity (NTU)
500
450
400
350
300
250
200
150
100
50
0
1
2
3
4
5
6
7
8
Settling Time (hr)
14-May
15-May
16-May
17-May
18-May
19-May
20-May
Avg

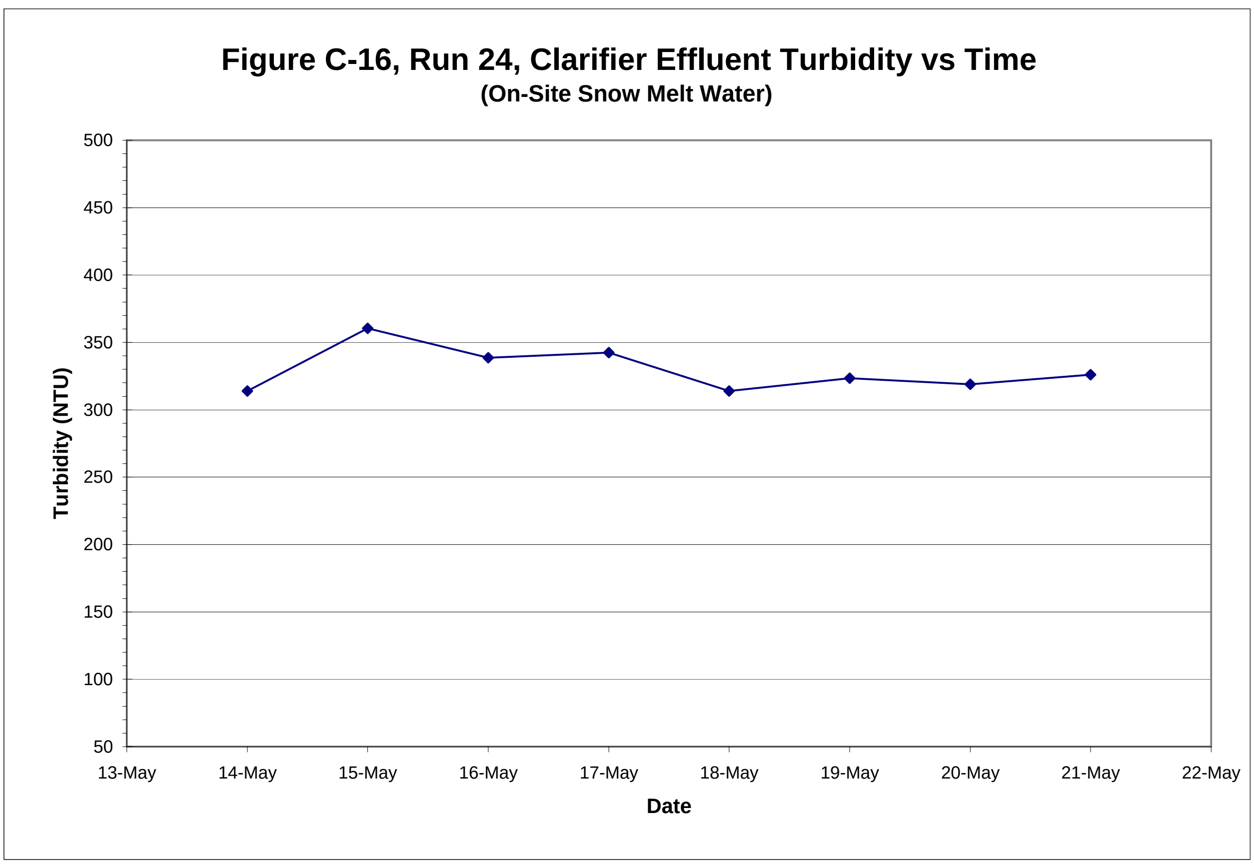
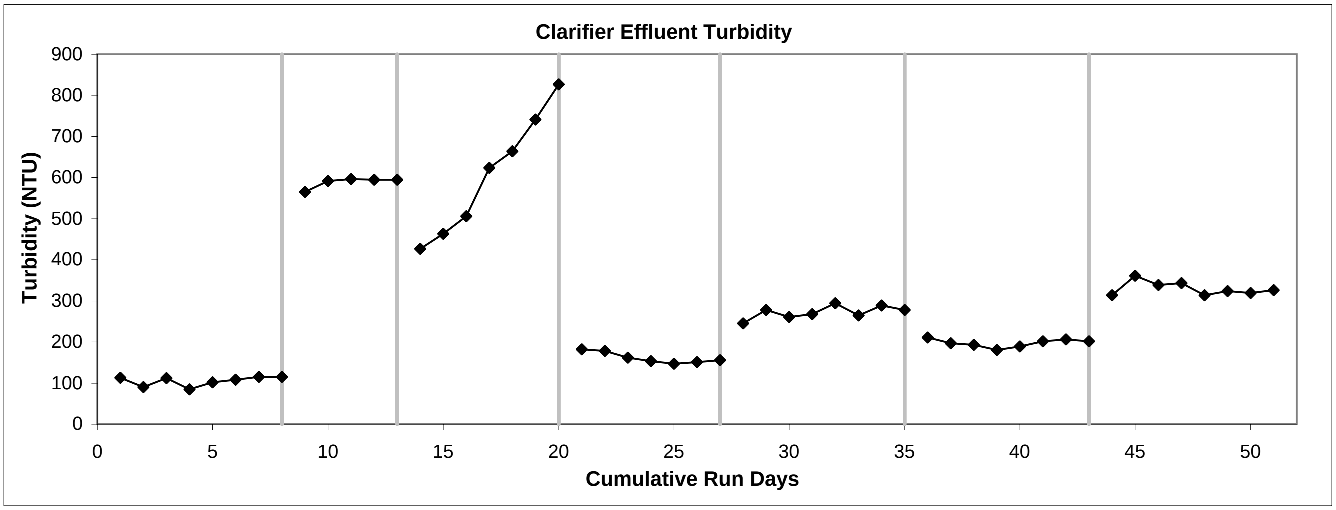
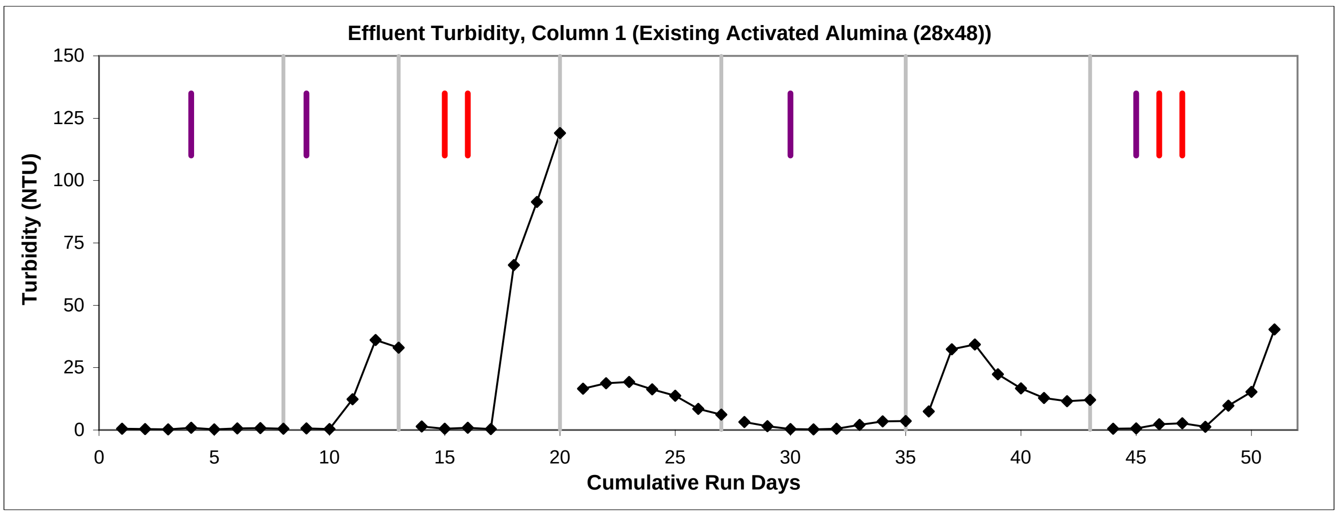


Figure C-16, Run 24, Clarifier Effluent Turbidity vs Time
(On-Site Snow Melt Water)
Turbidity (NTU)
500
450
400
350
300
250
200
150
100
50
13-May
14-May
15-May
16-May
17-May
18-May
19-May
20-May
21-May
22-May
Date

Figure Set C-17, Column 1 (Existing AA, 28x48) Influent and Effluent Turbidity, and Column Head





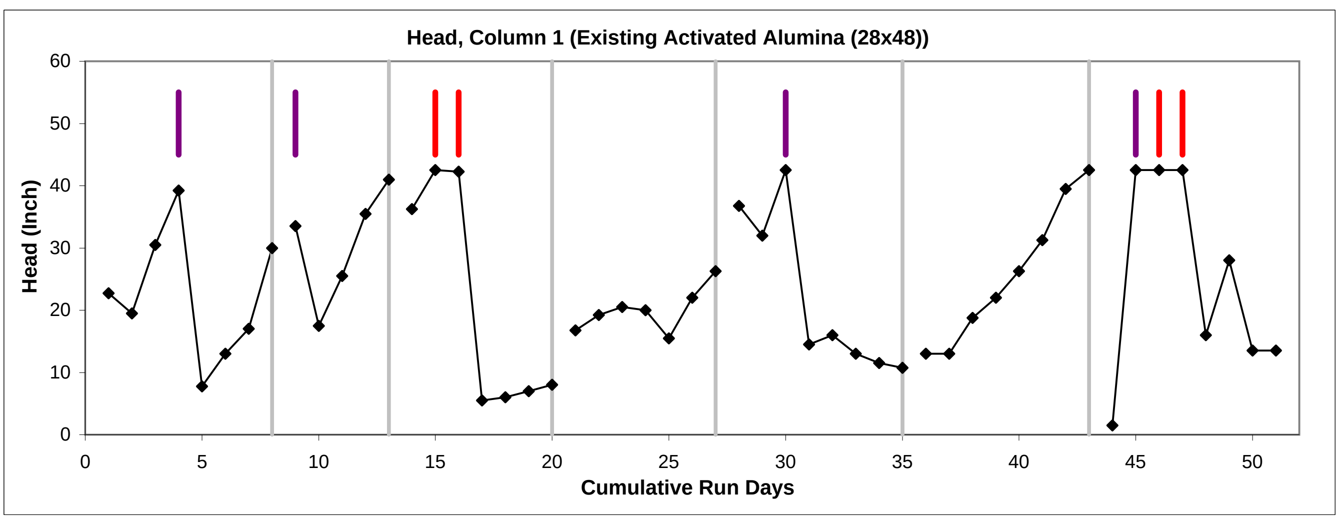
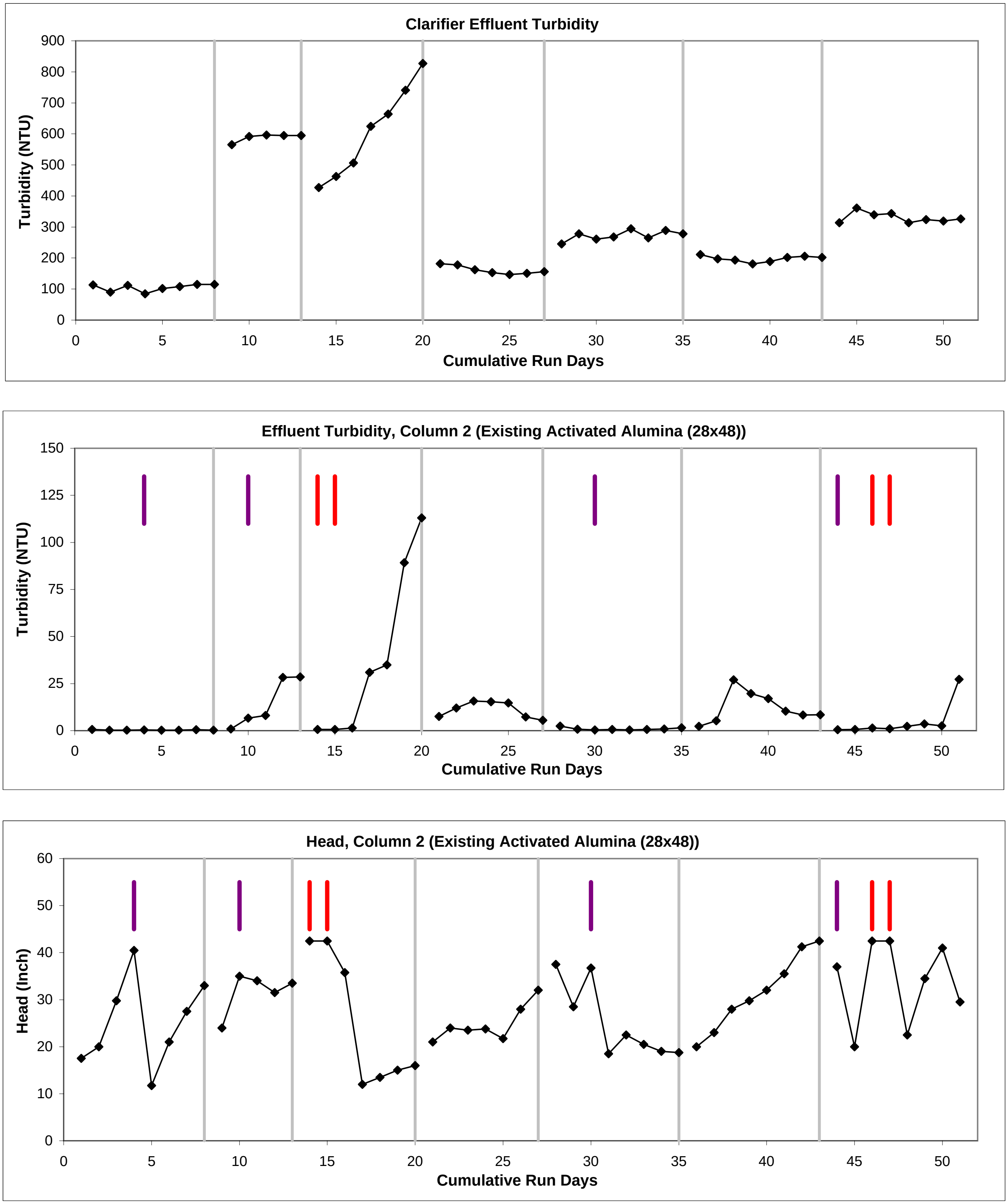


Figure Set C-18, Column 2 (Existing AA, 28x48) Influent and Effluent Turbidity, and Column Head



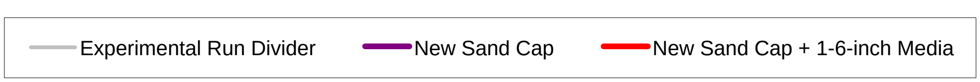
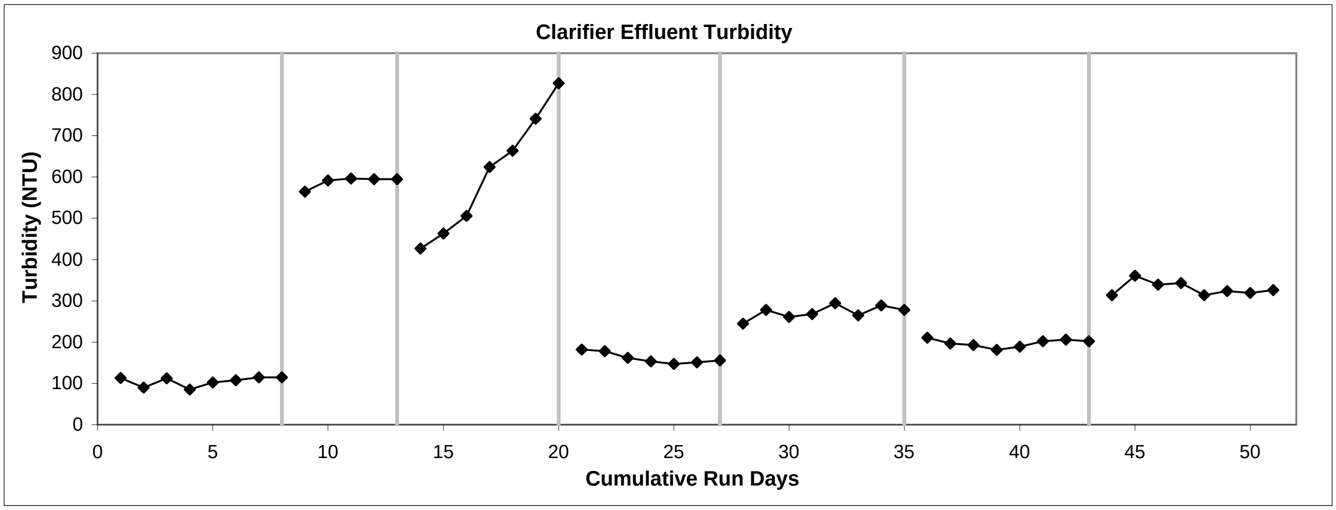
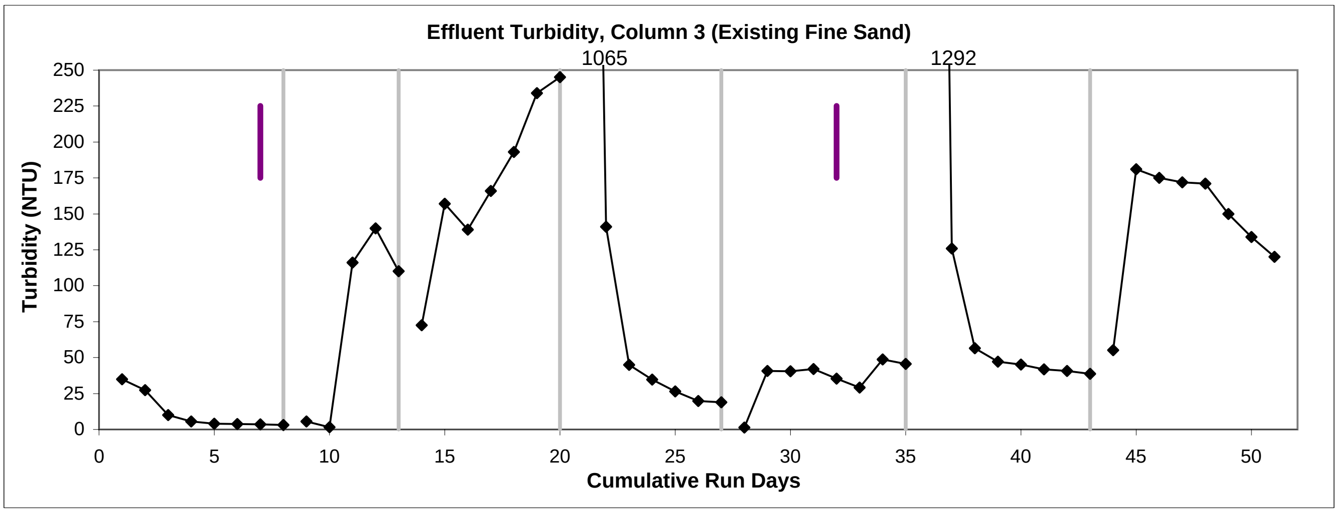
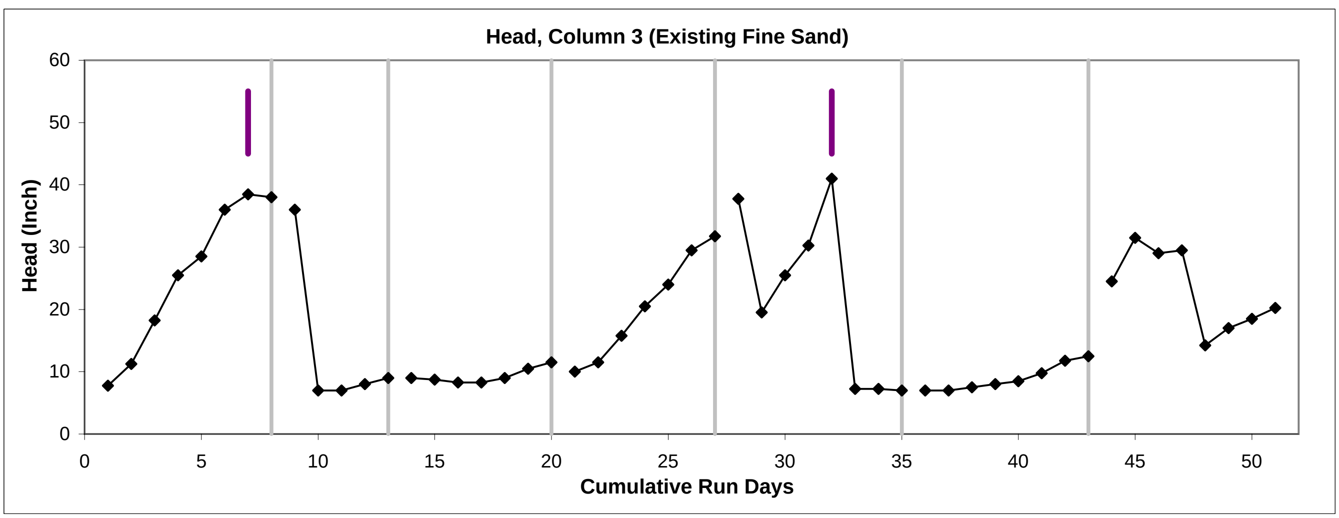


Figure Set C-19, Column 3 (Existing F-105 Sand) Influent and Effluent Turbidity, and Column Head







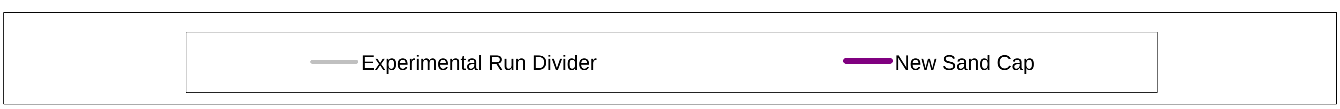


Figure Set C-20, Column 4 (Existing F-105 Sand) Influent and Effluent Turbidity, and Column Head

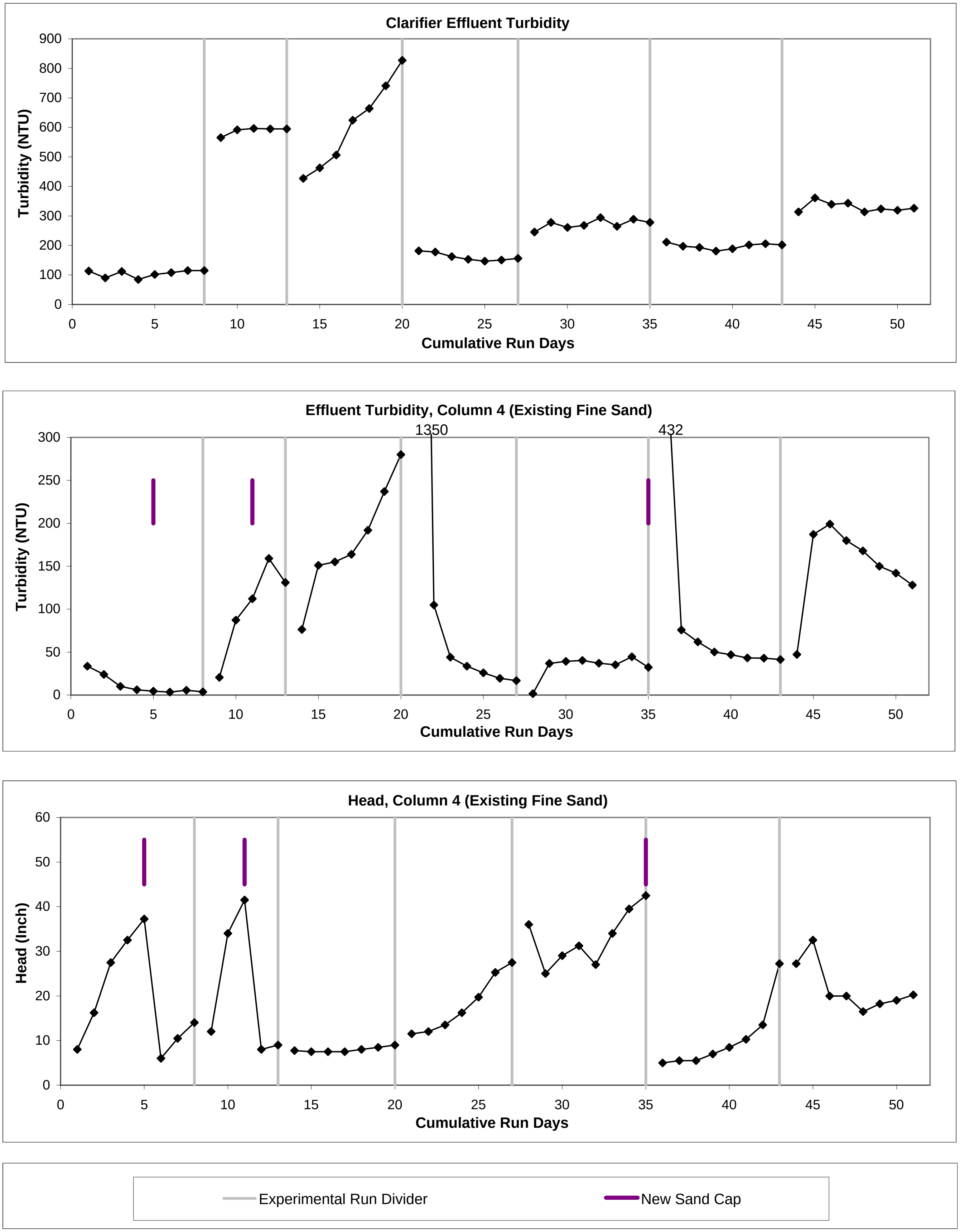


Figure Set C-21, Column 5 (New 28x48 AA) Influent and Effluent Turbidity, and Column Head

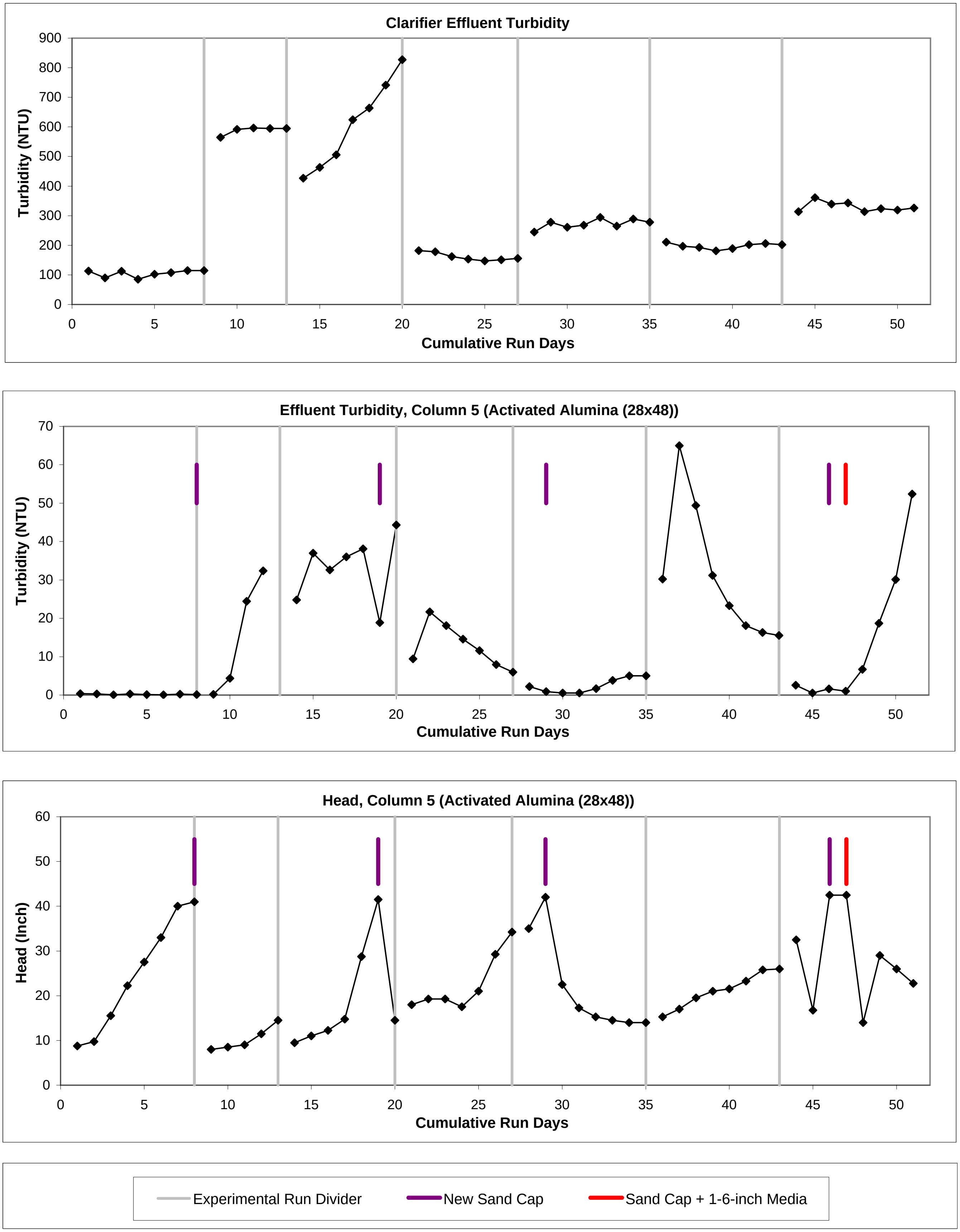
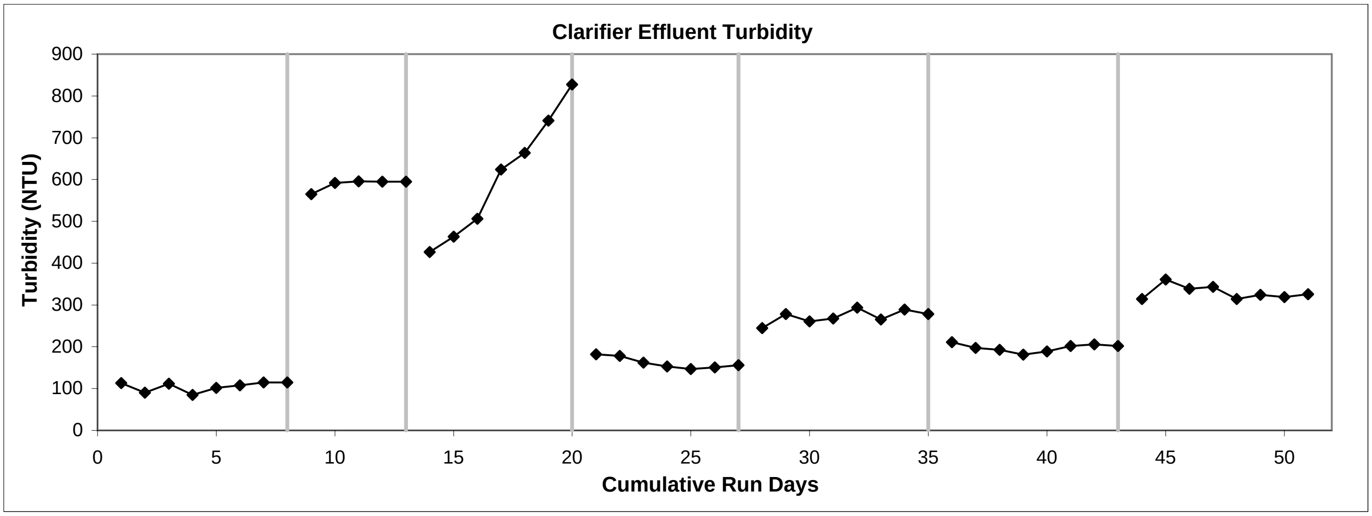
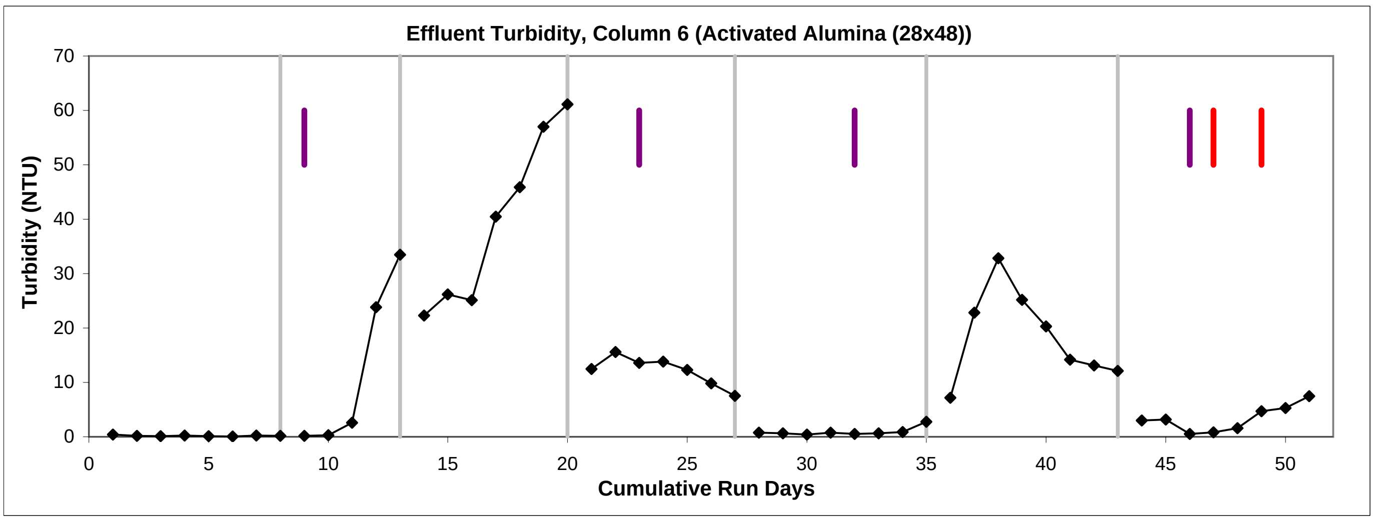
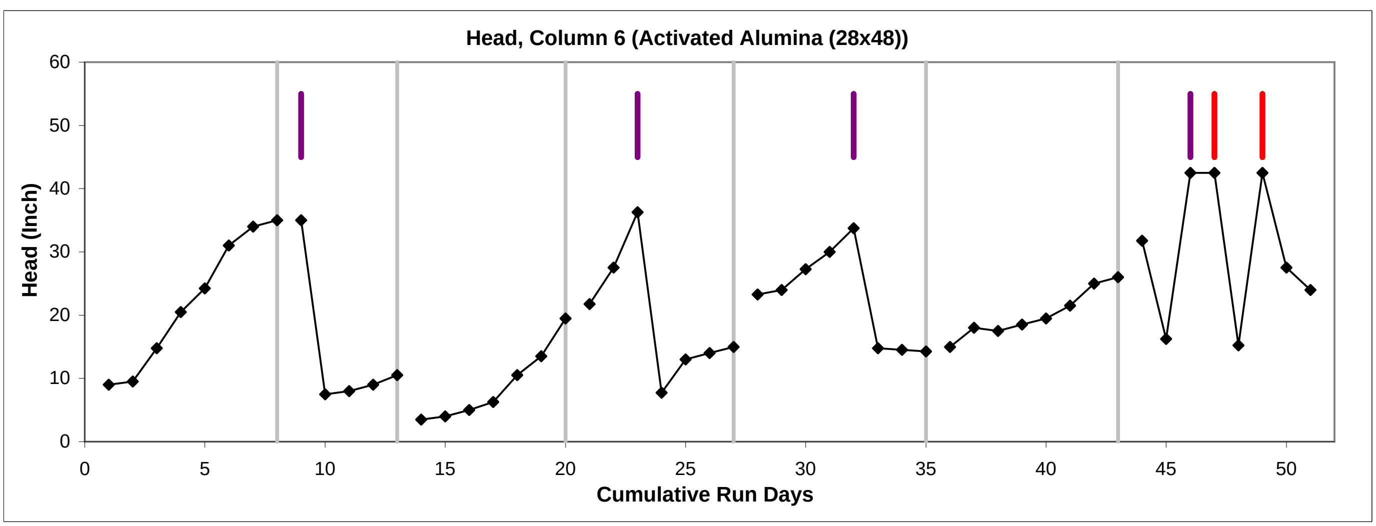


Figure Set C-22, Column 6 (New 28x48 AA) Influent and Effluent Turbidity, and Column Head







Experimental Run Divider   New Sand Cap   New Sand Cap + 1-6-inch Media

Figure Set C-23, Column 7 (New 14x28 AA) Influent and Effluent Turbidity, and Column Head

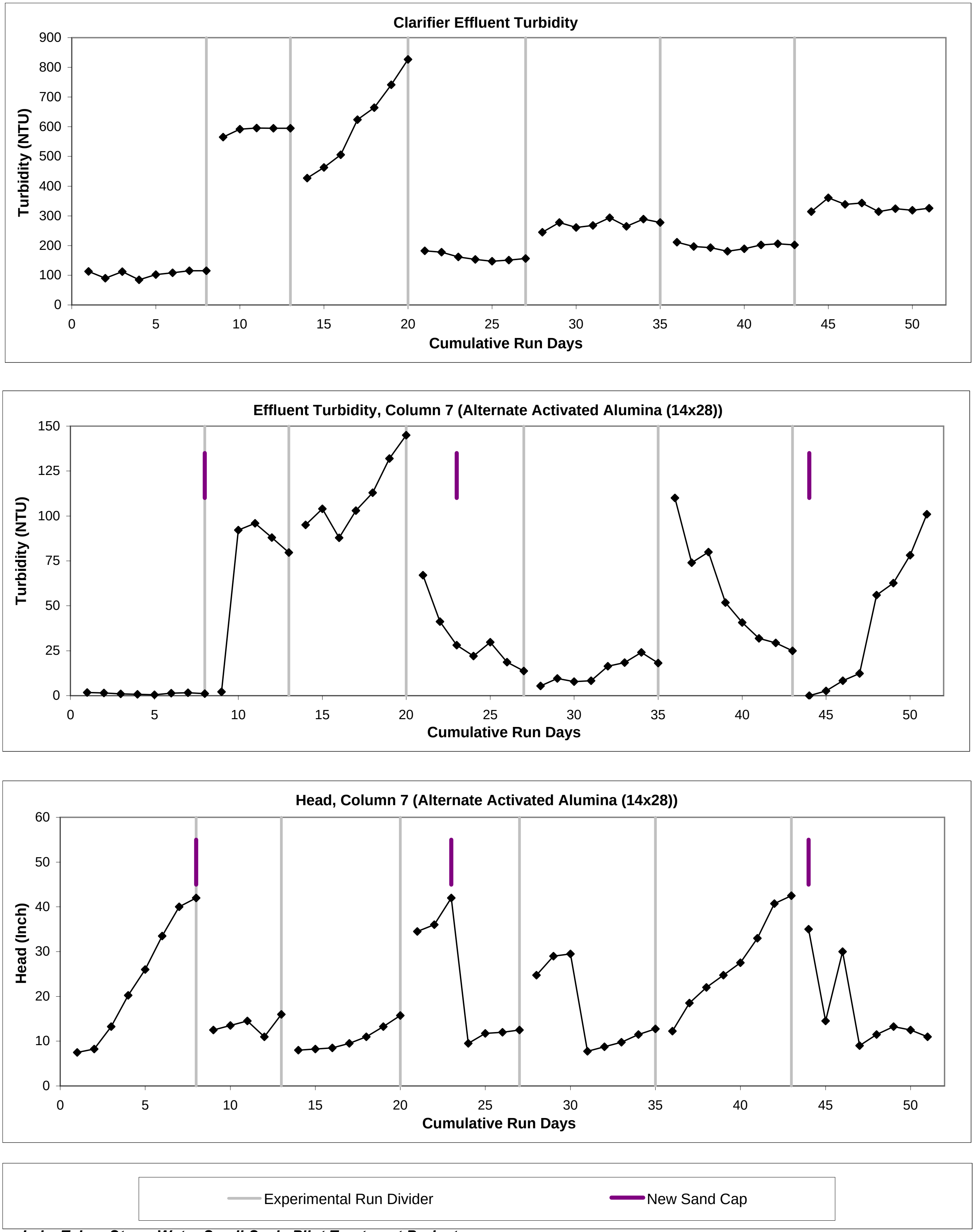
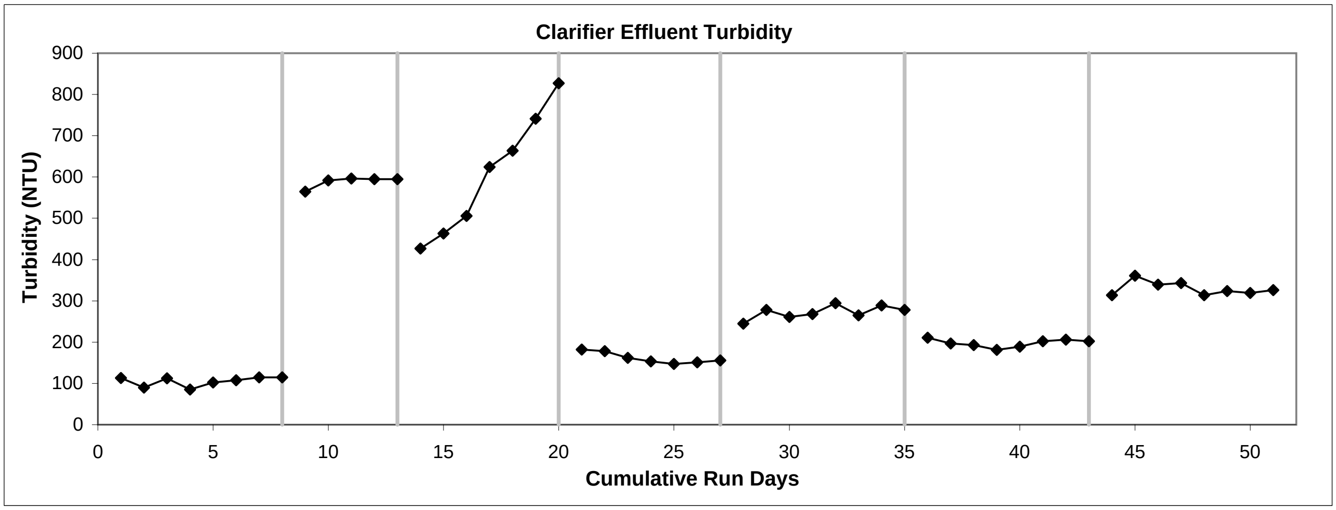
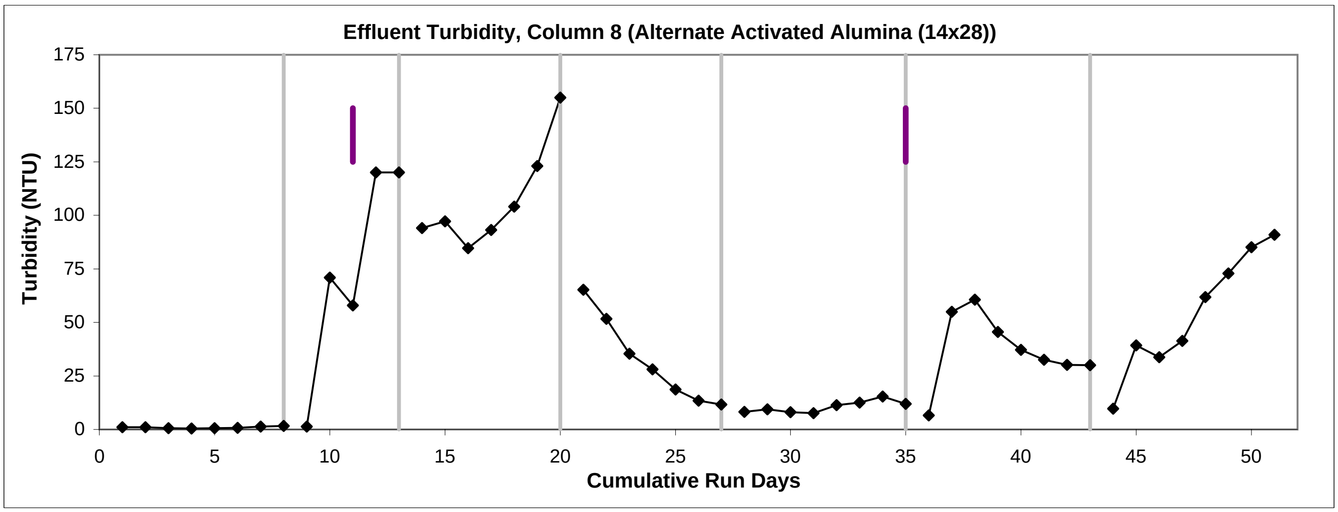


Figure Set C-24, Column 8 (New 14x28 AA) Influent and Effluent Turbidity, and Column Head





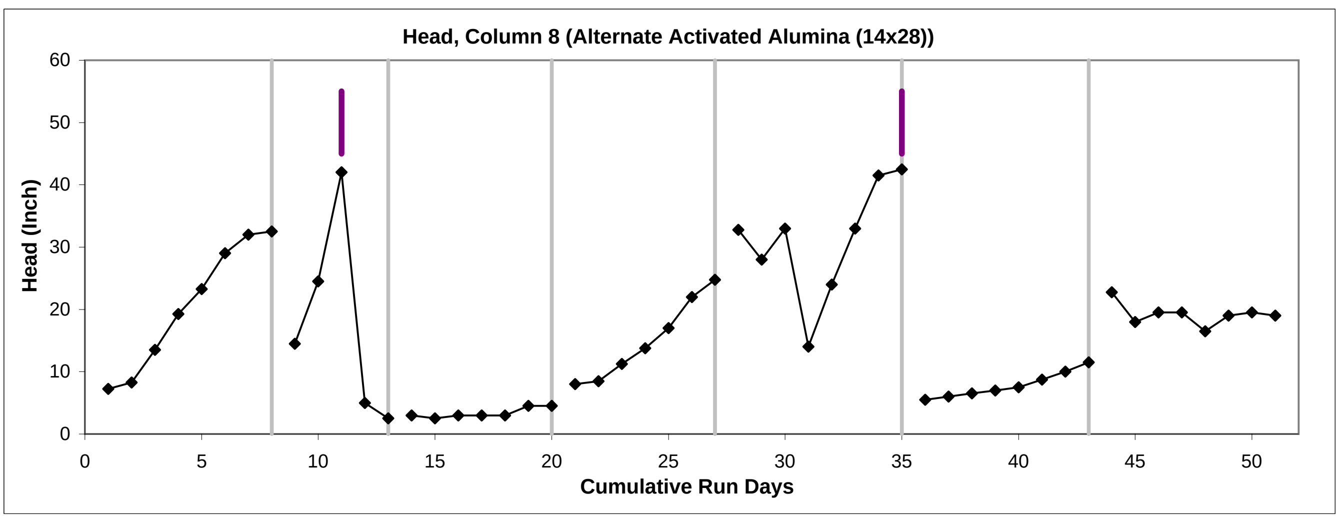
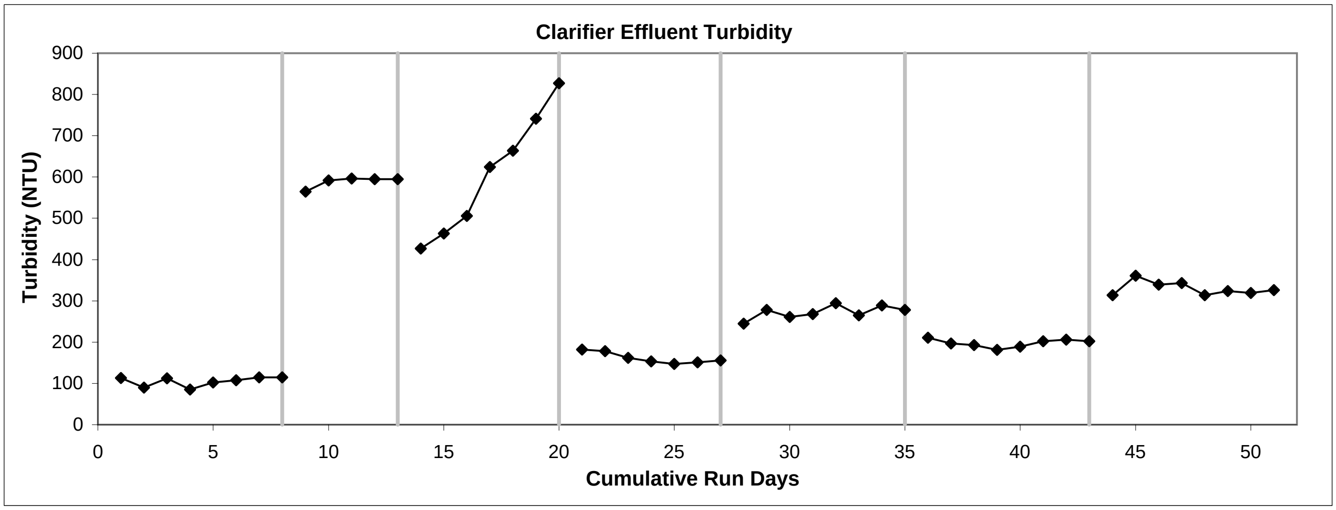
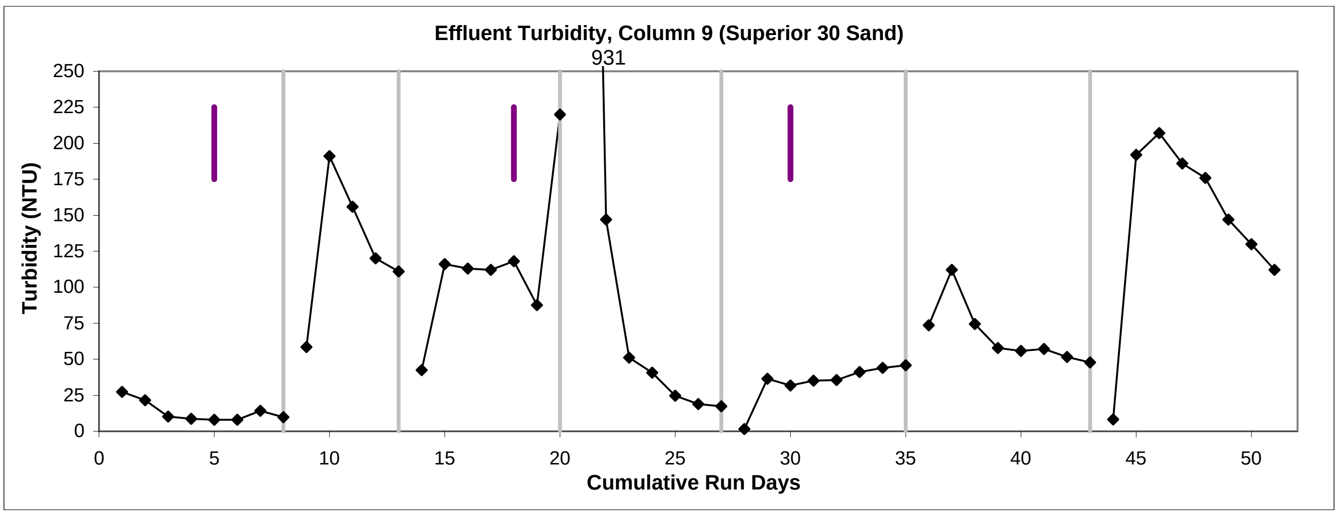
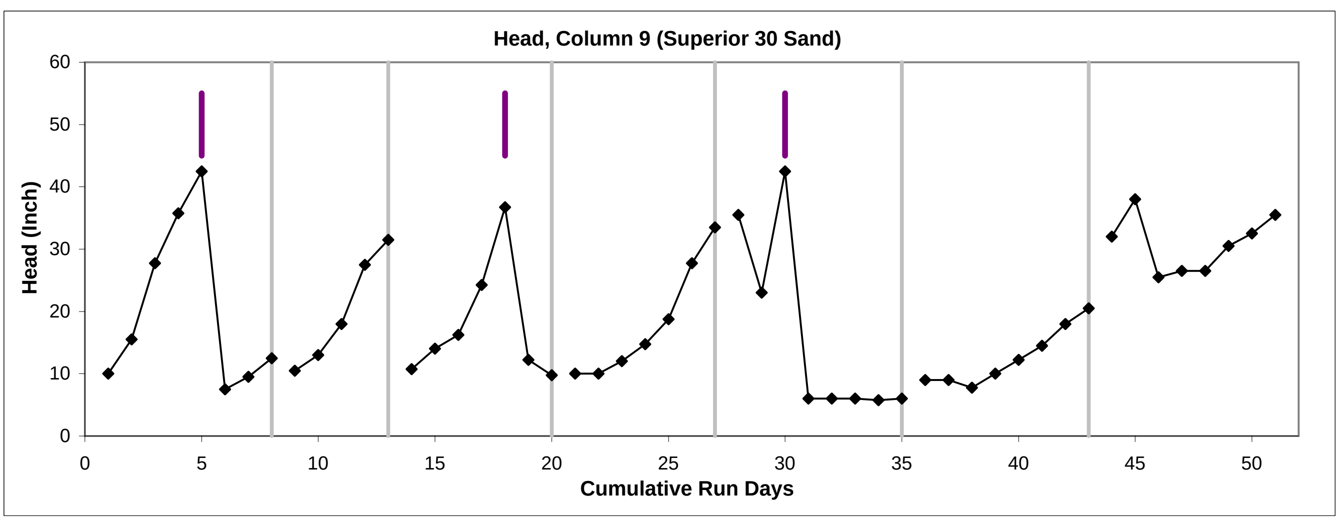


Figure Set C-25, Column 9 (Superior 30 Sand) Influent and Effluent Turbidity, and Column Head







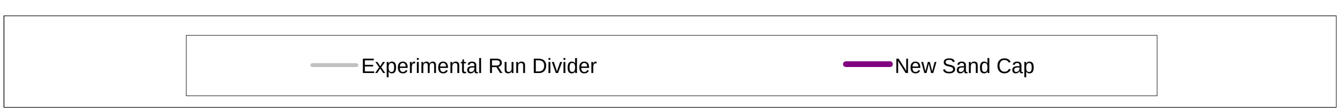
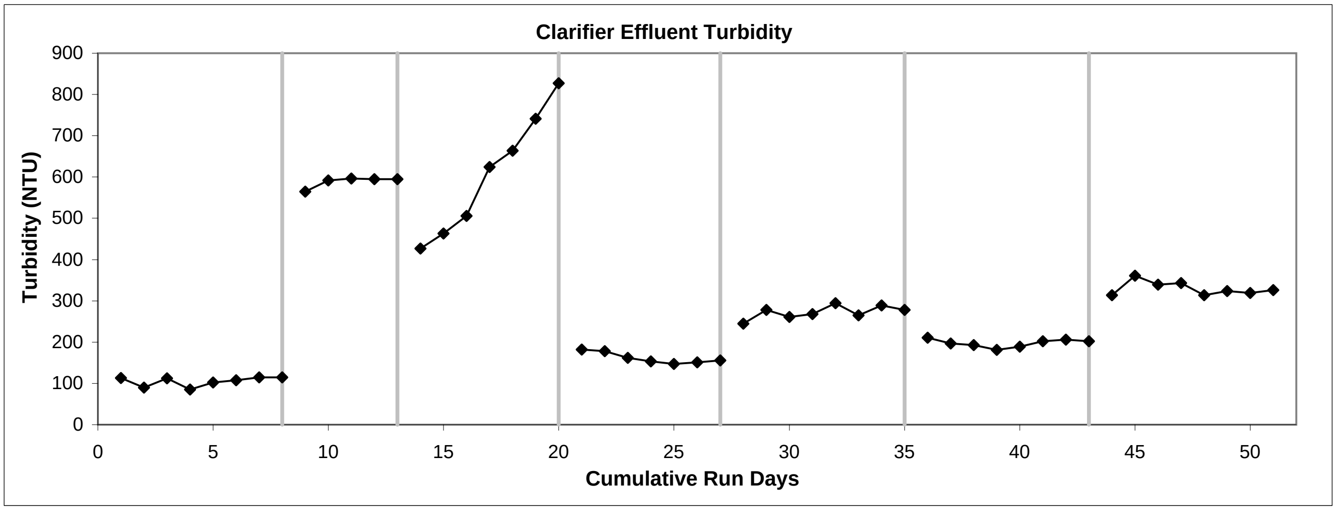
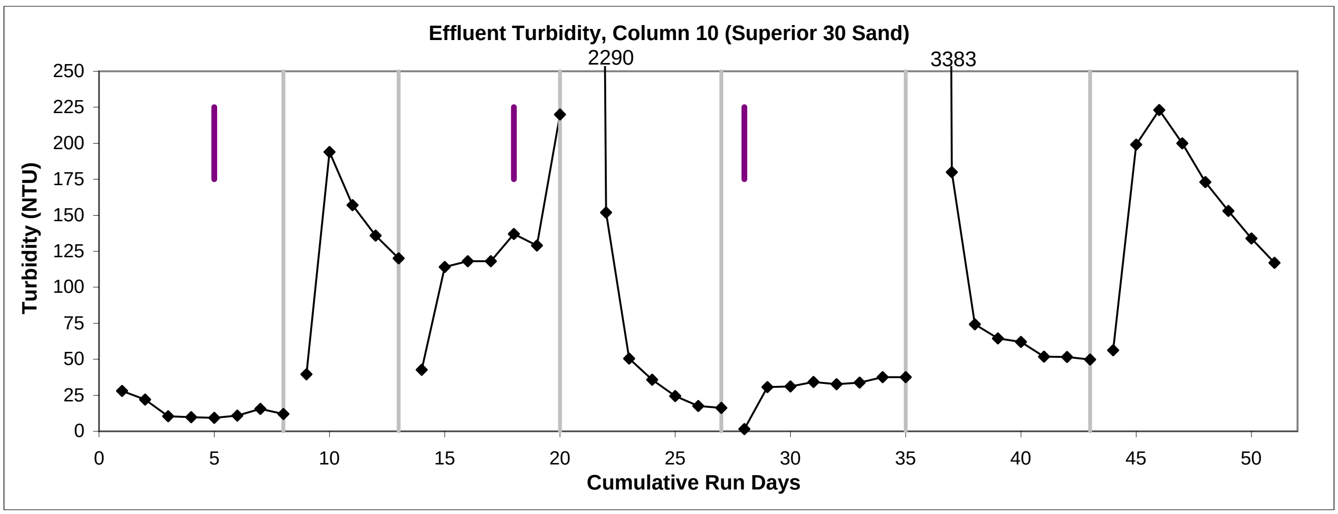
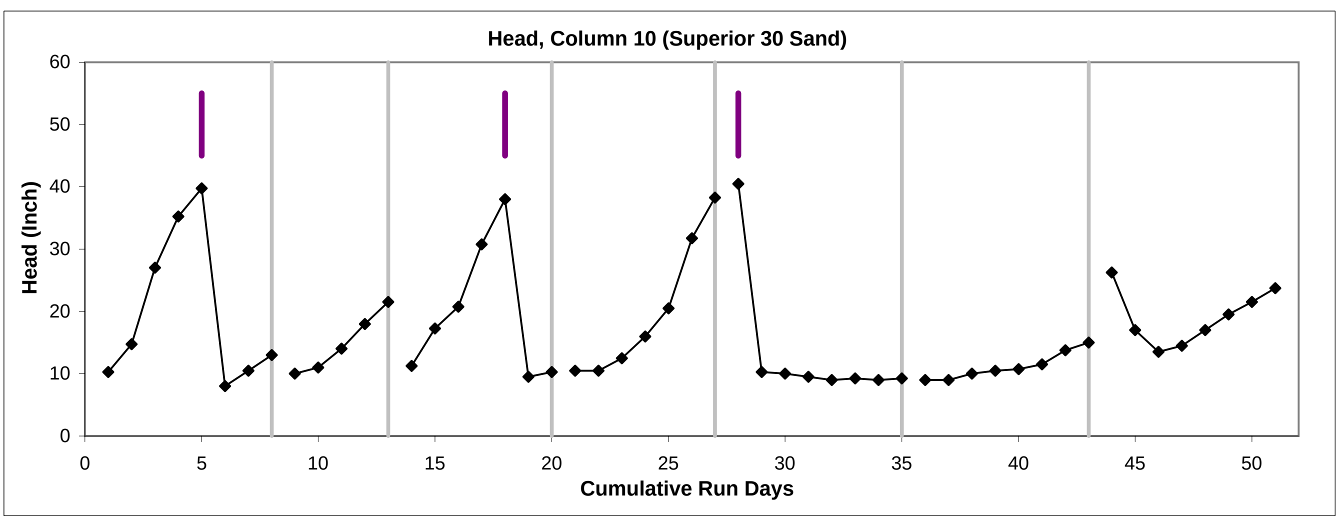


Figure Set C-26, Column 10 (Superior 30 Sand) Influent and Effluent Turbidity, and Column Head







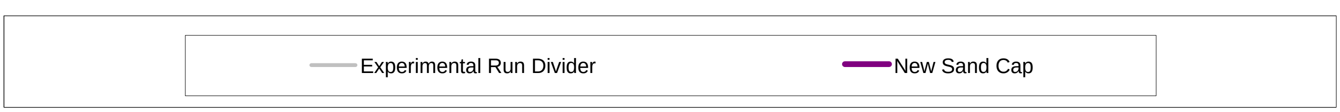
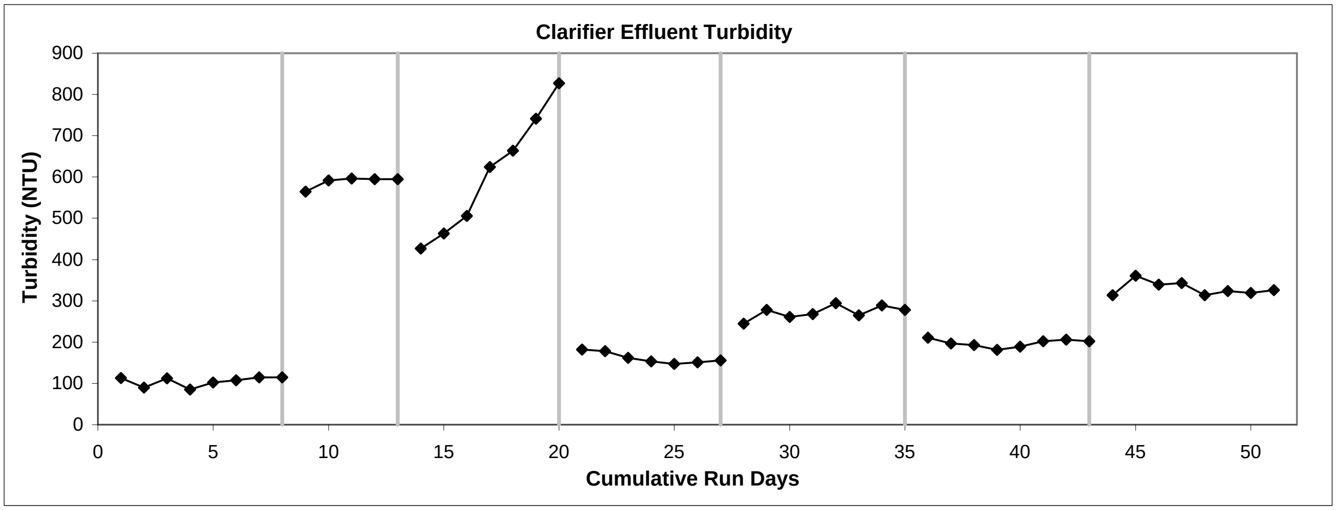
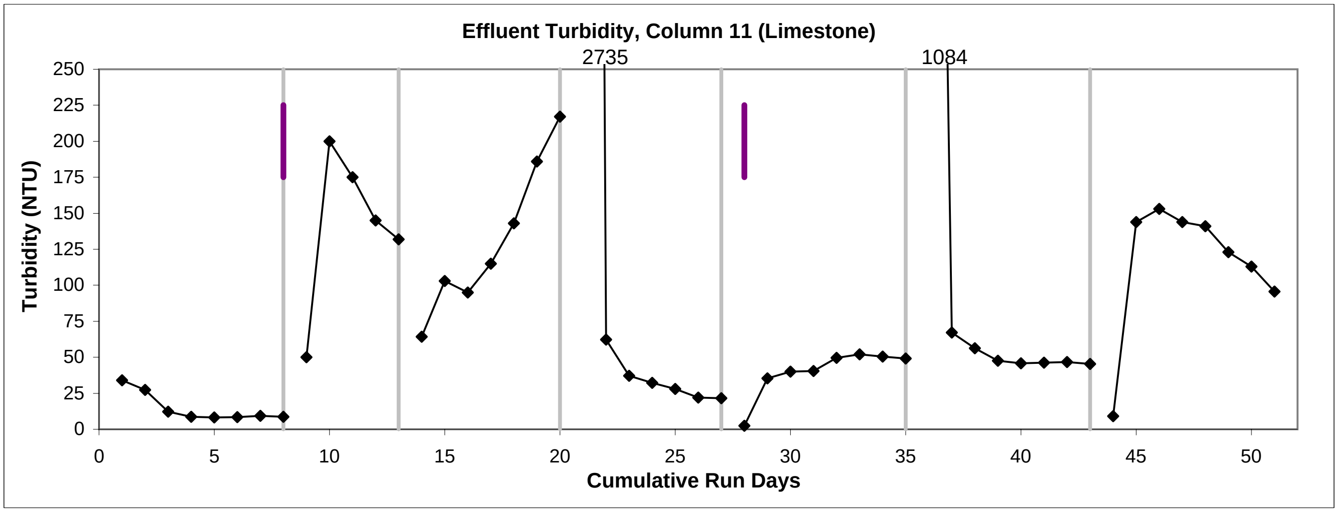


Figure Set C-27, Column 11 (Limestone) Influent and Effluent Turbidity, and Column Head





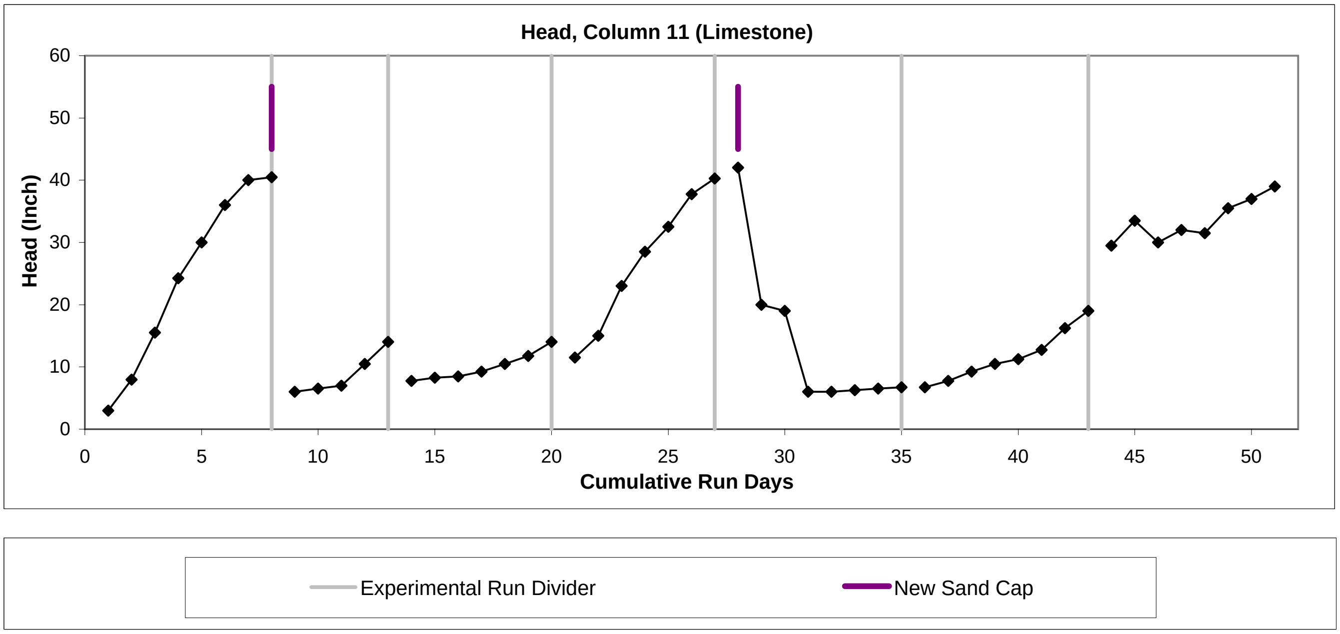


Figure Set C-28, Column 12 (Limestone) Influent and Effluent Turbidity, and Column Head

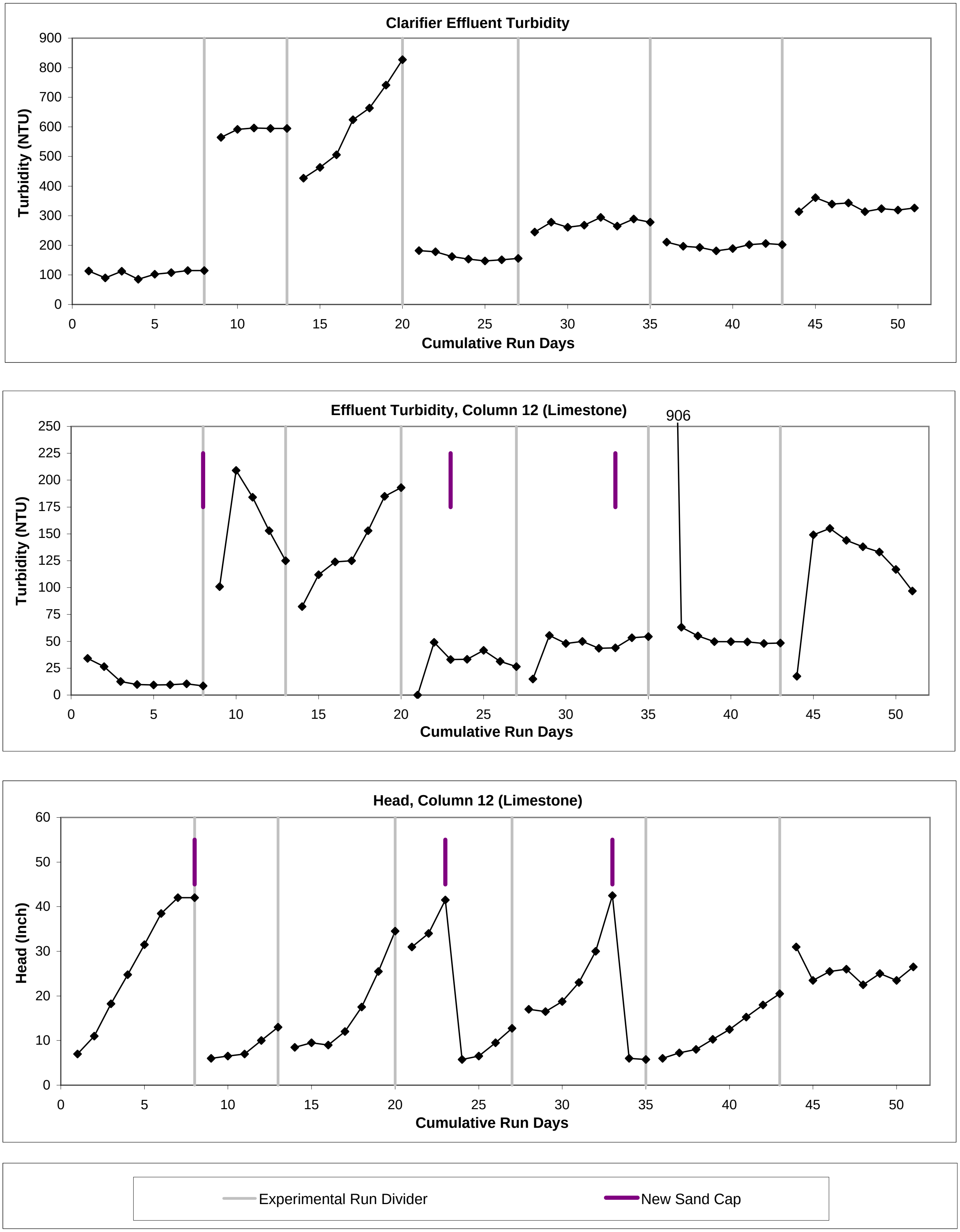
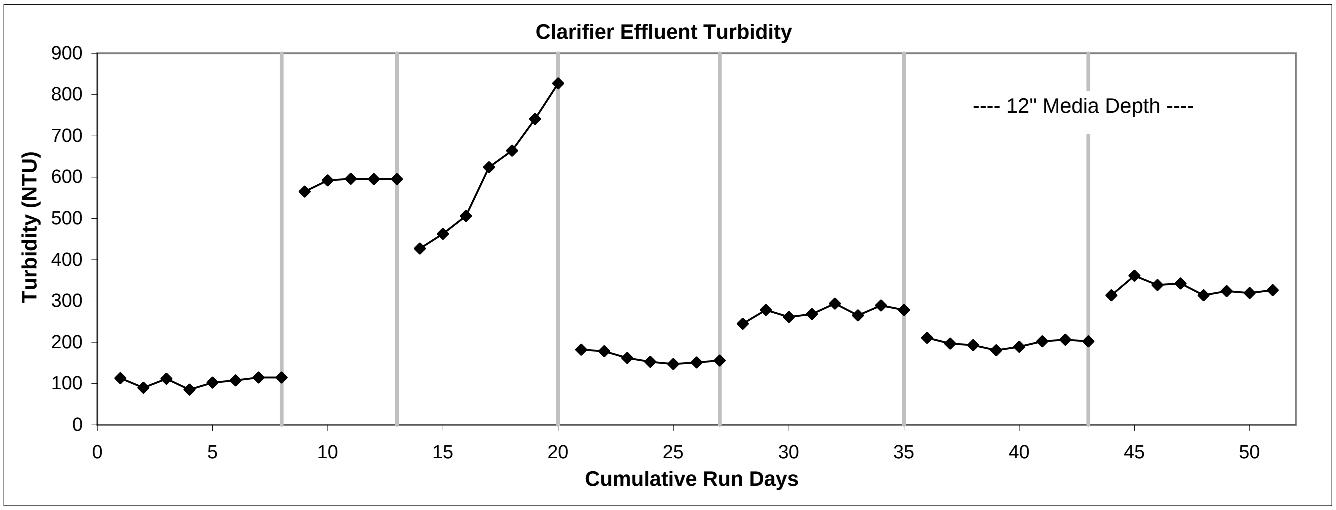
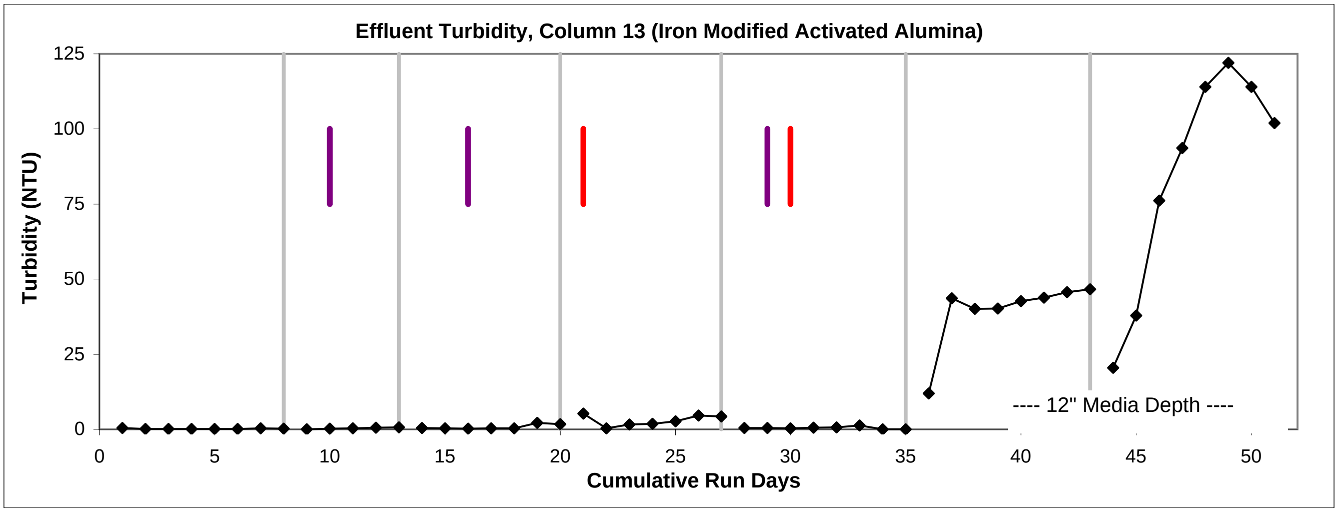


Figure Set C-29, Column 13 (Fe-Mod. AA) Influent and Effluent Turbidity, and Column Head





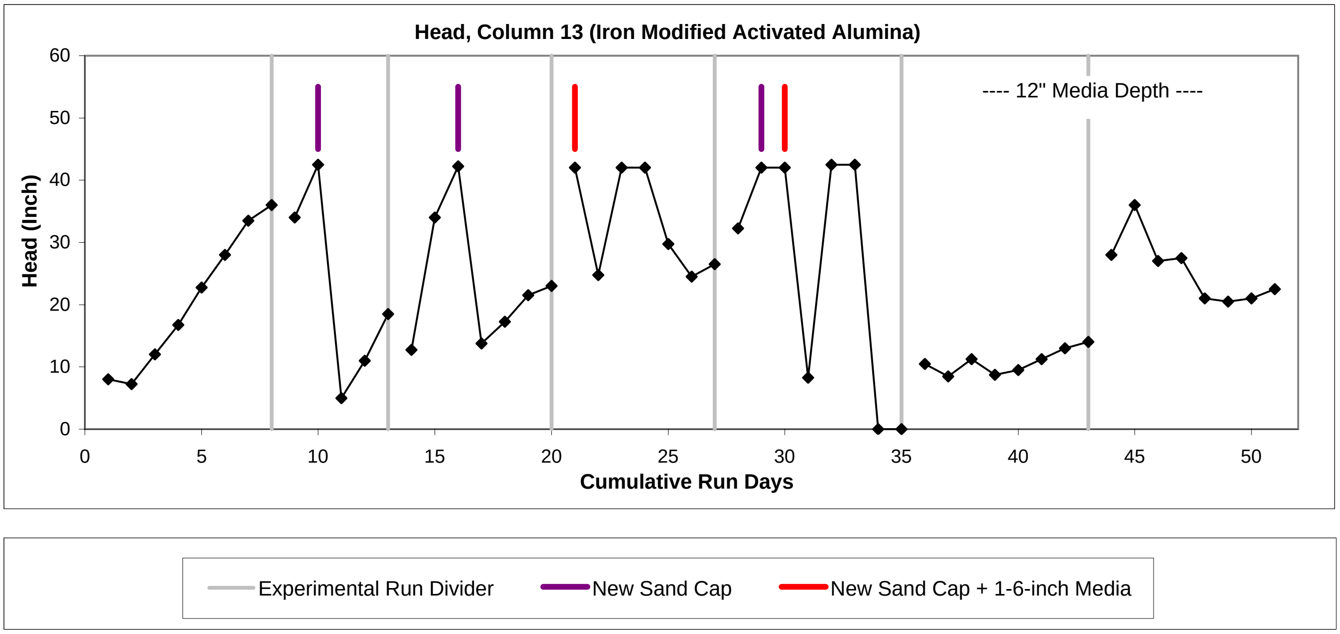


Figure Set C-30, Column 14 (Fe-Mod. AA) Influent and Effluent Turbidity, and Column Head

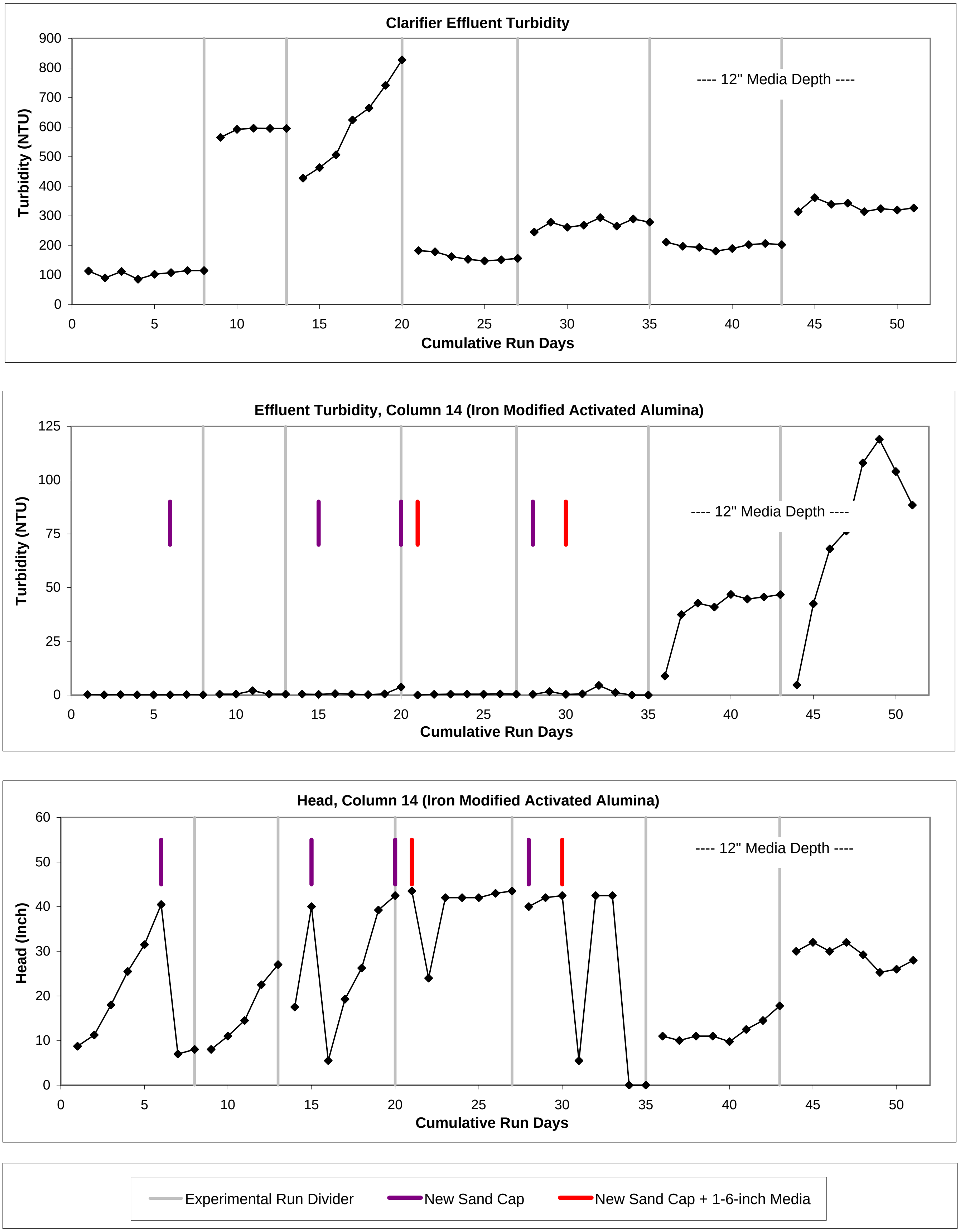


Figure Set C-31, Column 15 (GFH) Influent and Effluent Turbidity, and Column Head

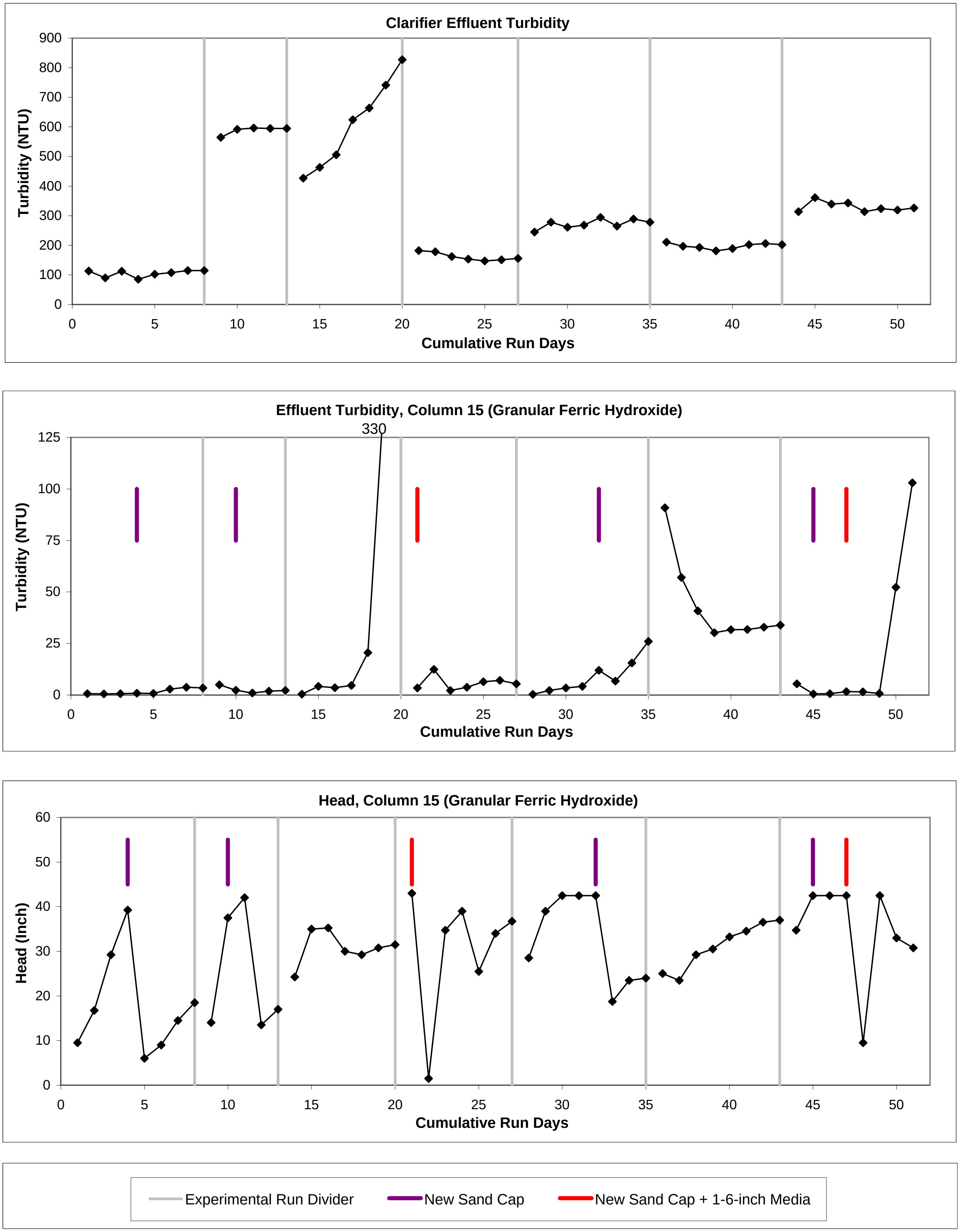
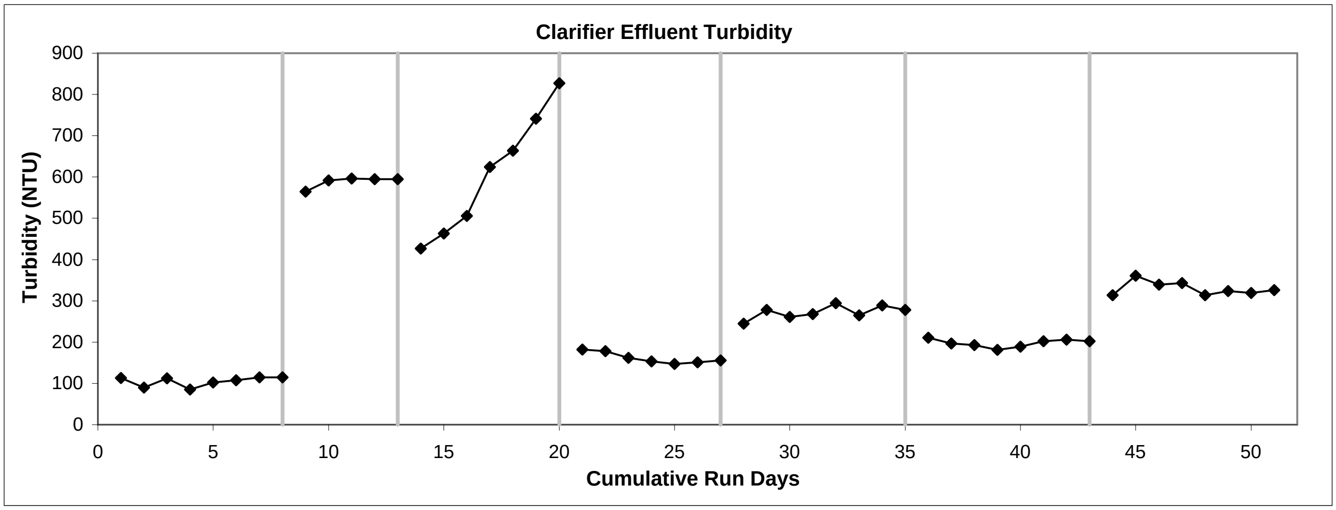
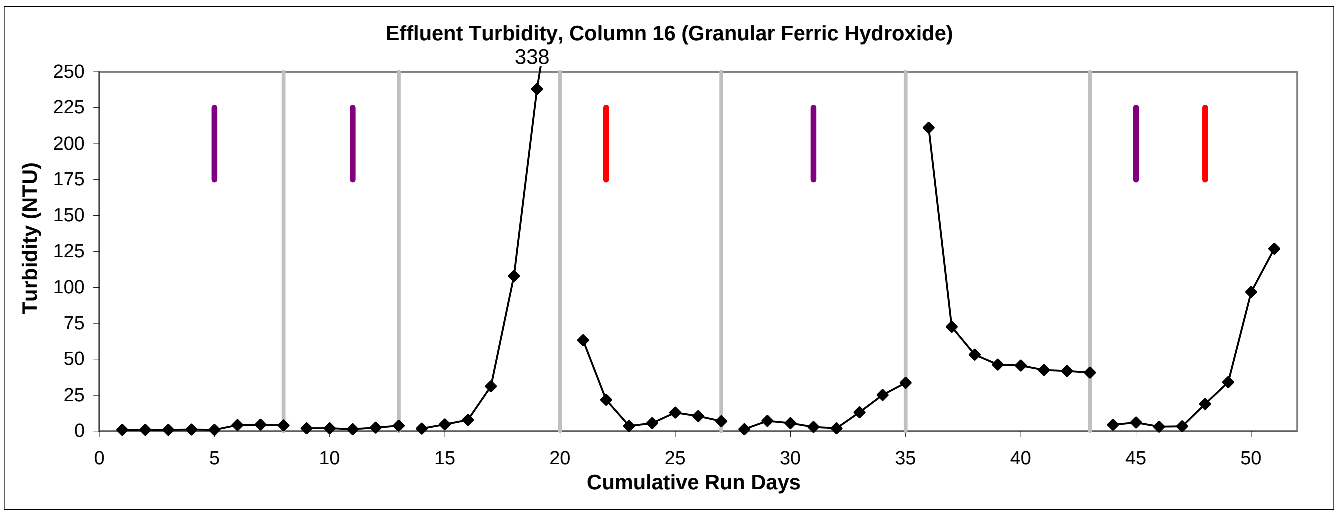
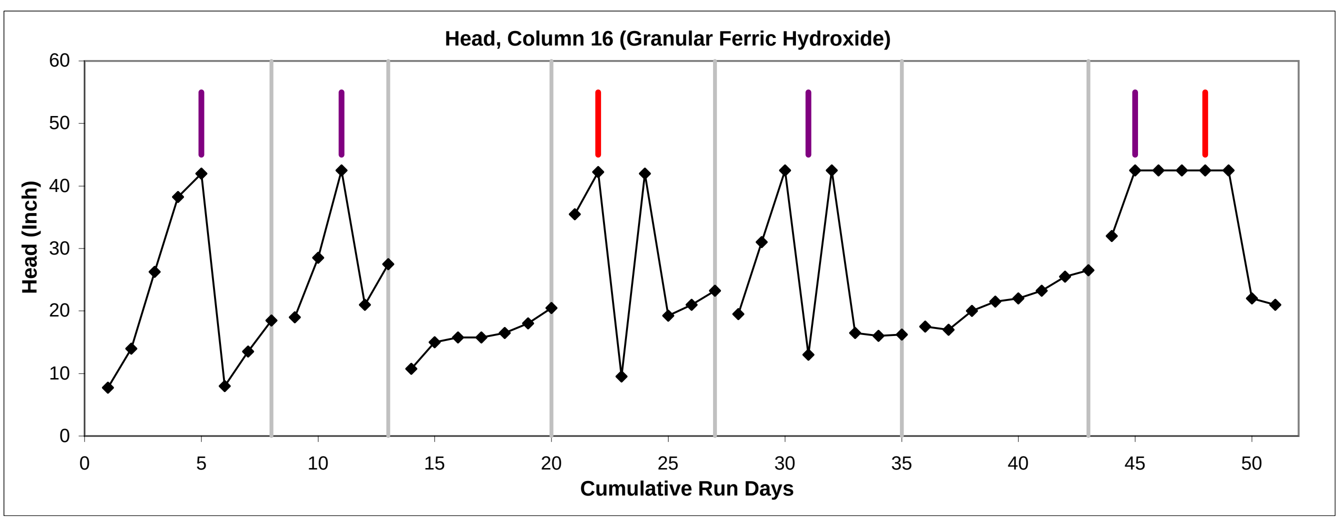


Figure Set C-32, Column 16 (GFH) Influent and Effluent Turbidity, and Column Head







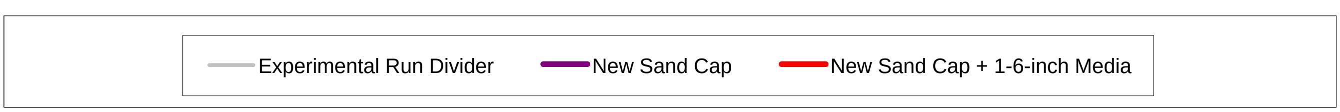
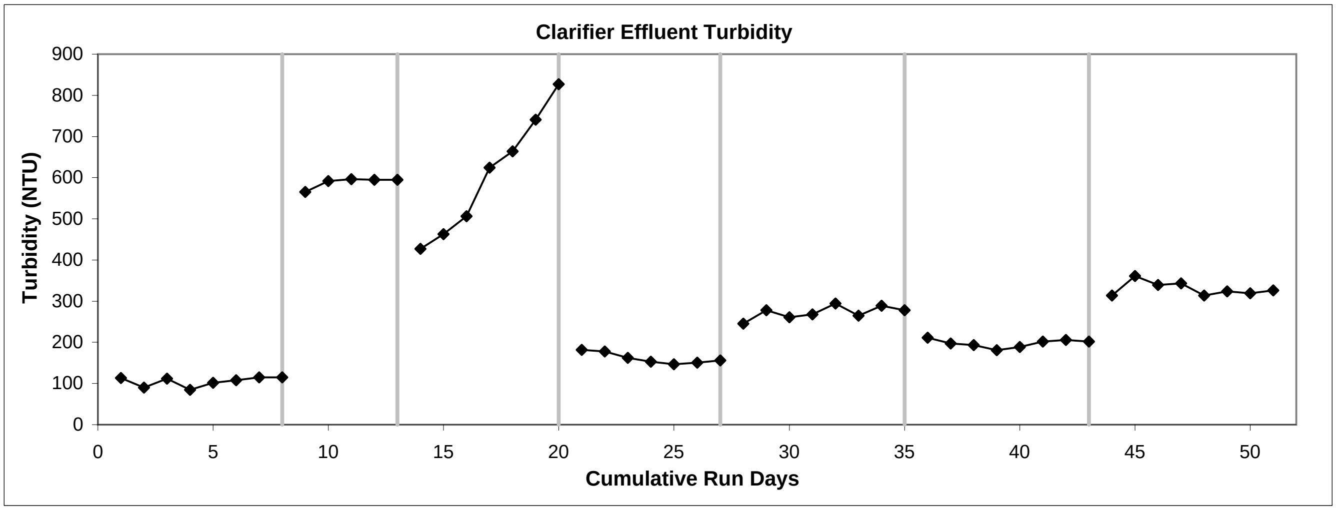
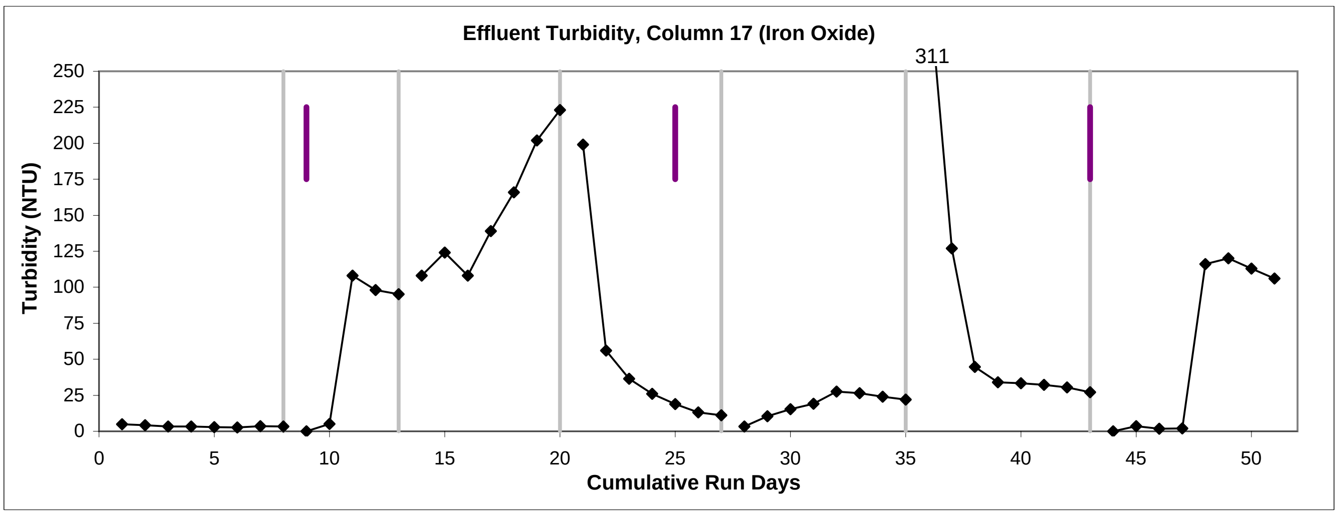
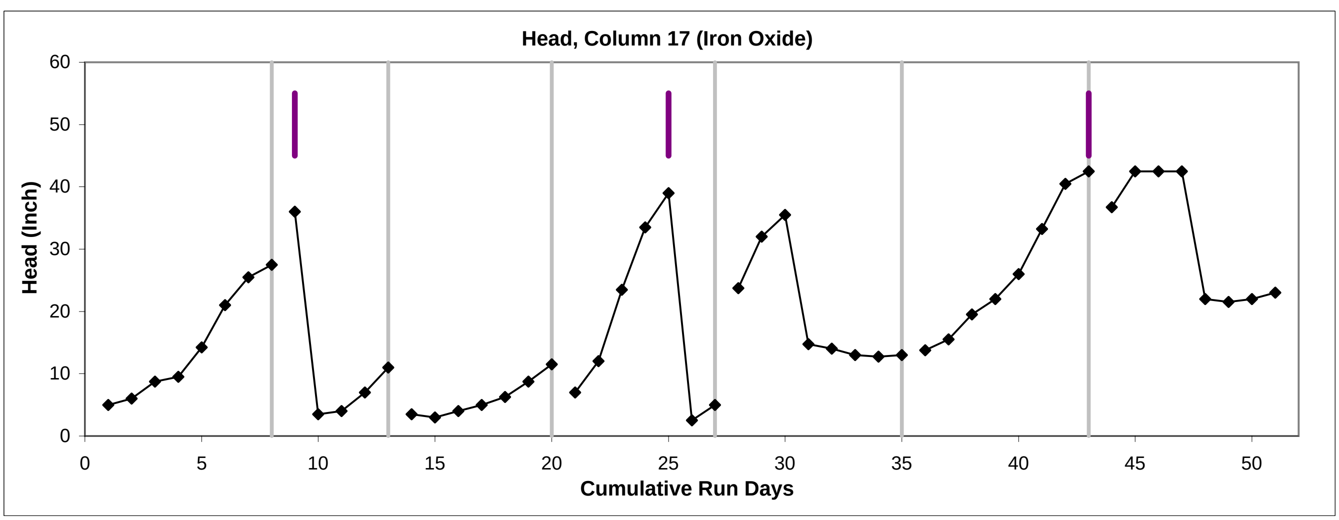


Figure Set C-33, Column 17 (Bayoxide E-33) Influent and Effluent Turbidity, and Column Head







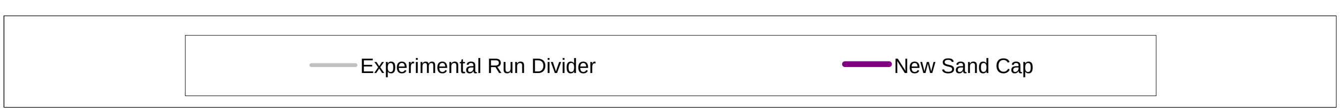


Figure Set C-34, Column 18 (Bayoxide E-33) Influent and Effluent Turbidity, and Column Head

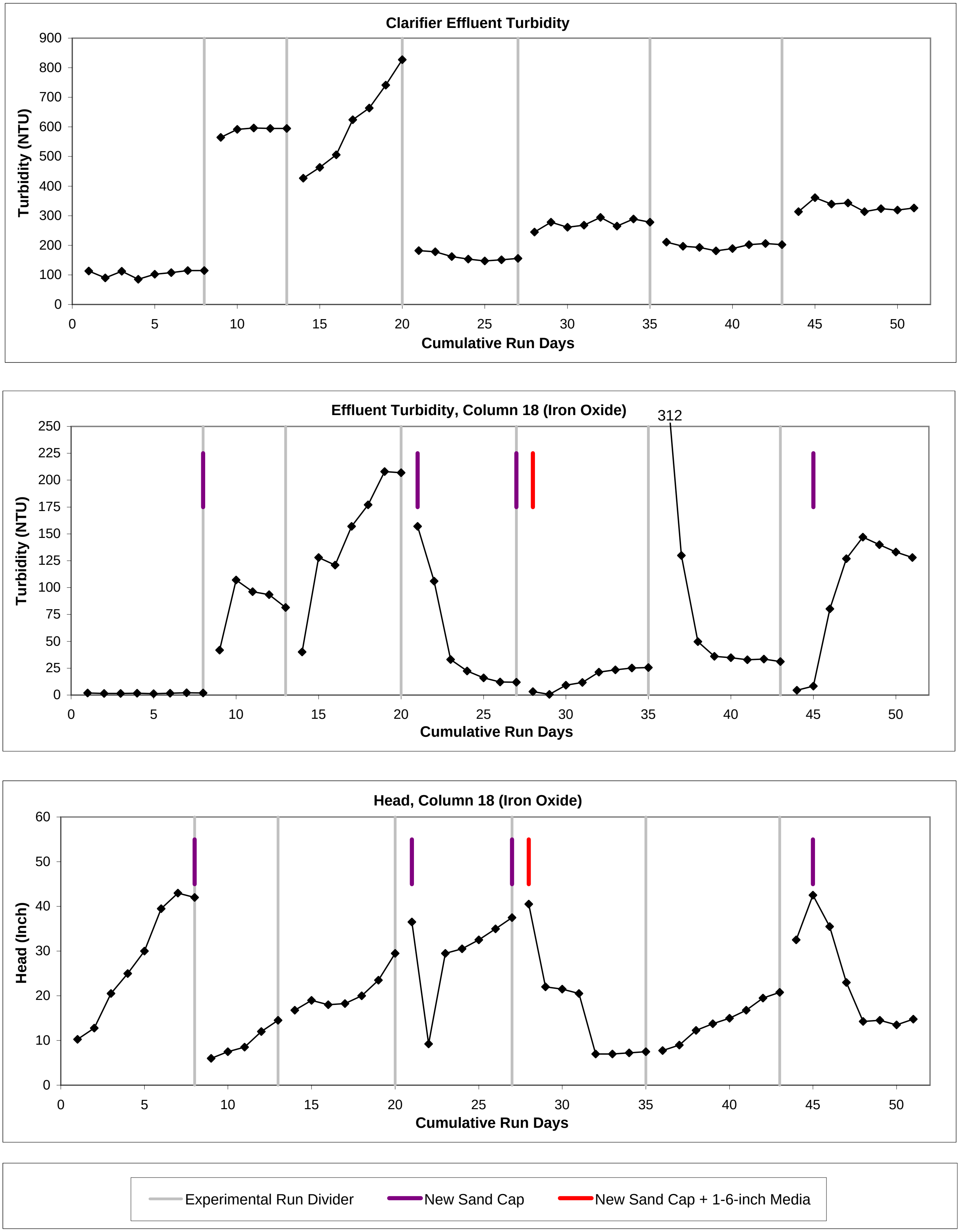


Figure C-35, Turbidity, Columns 1 & 2 (Existing Activated Alumina, 28/48)

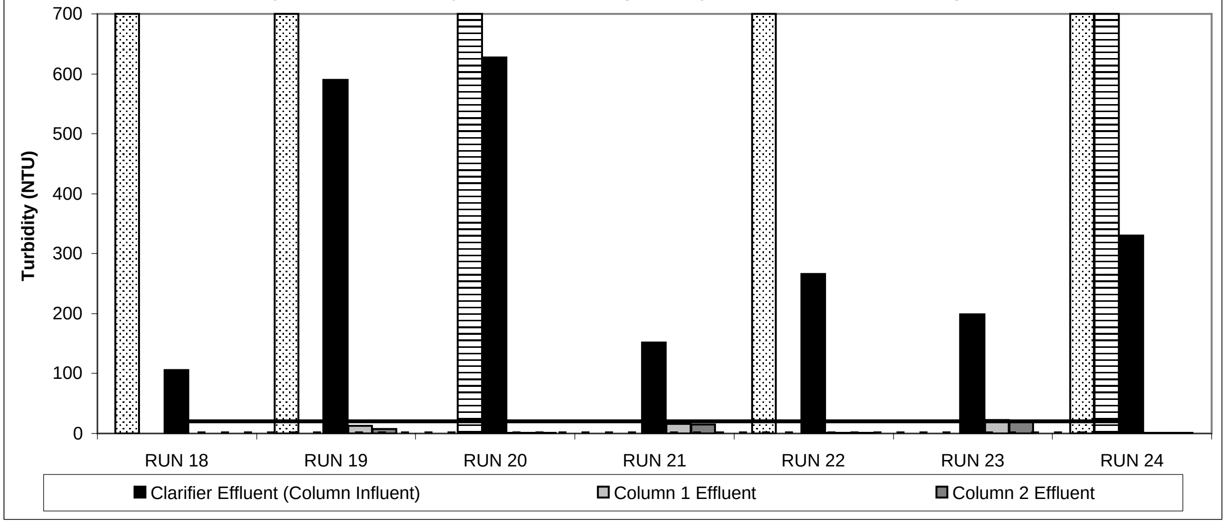


Figure C-36, Turbidity, Columns 3 & 4 (Existing F-105 Filter Sand)

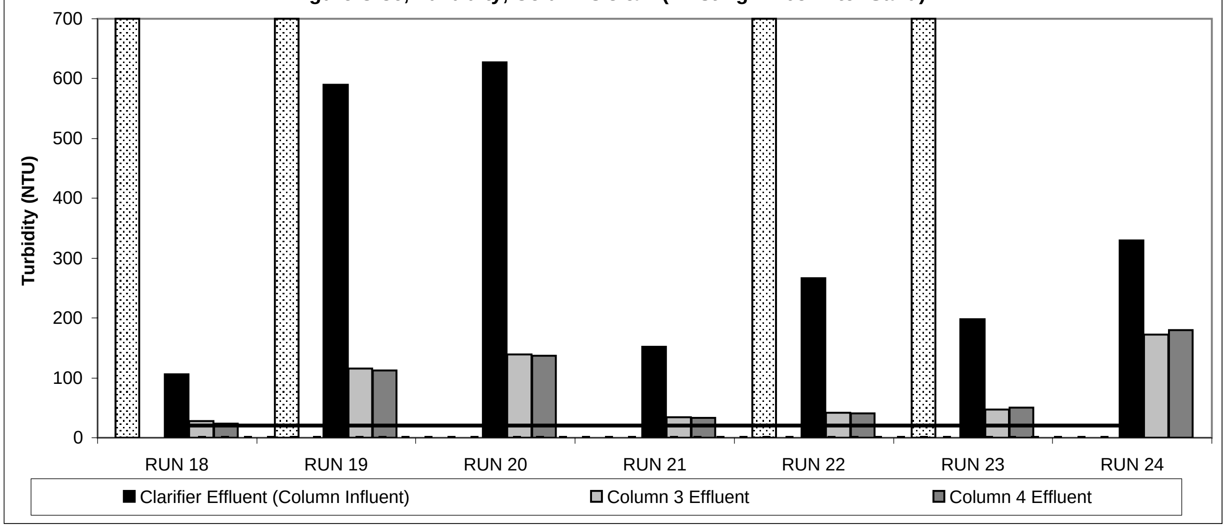
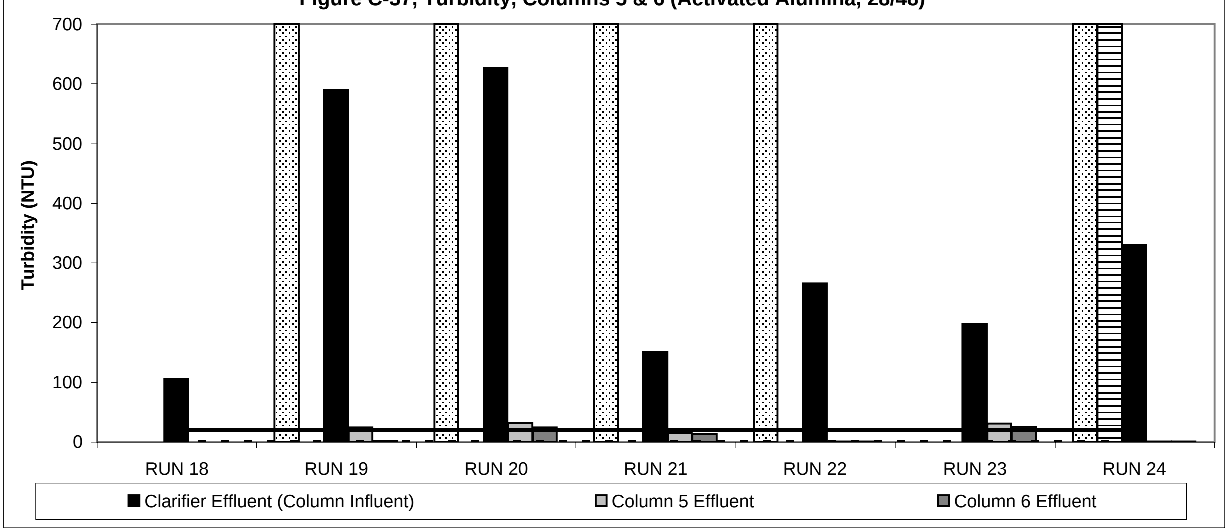
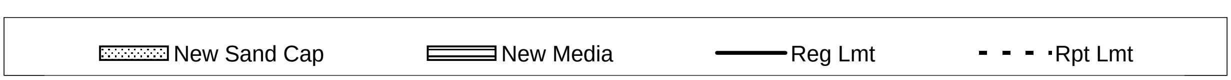


Figure C-37, Turbidity, Columns 5 & 6 (Activated Alumina, 28/48)





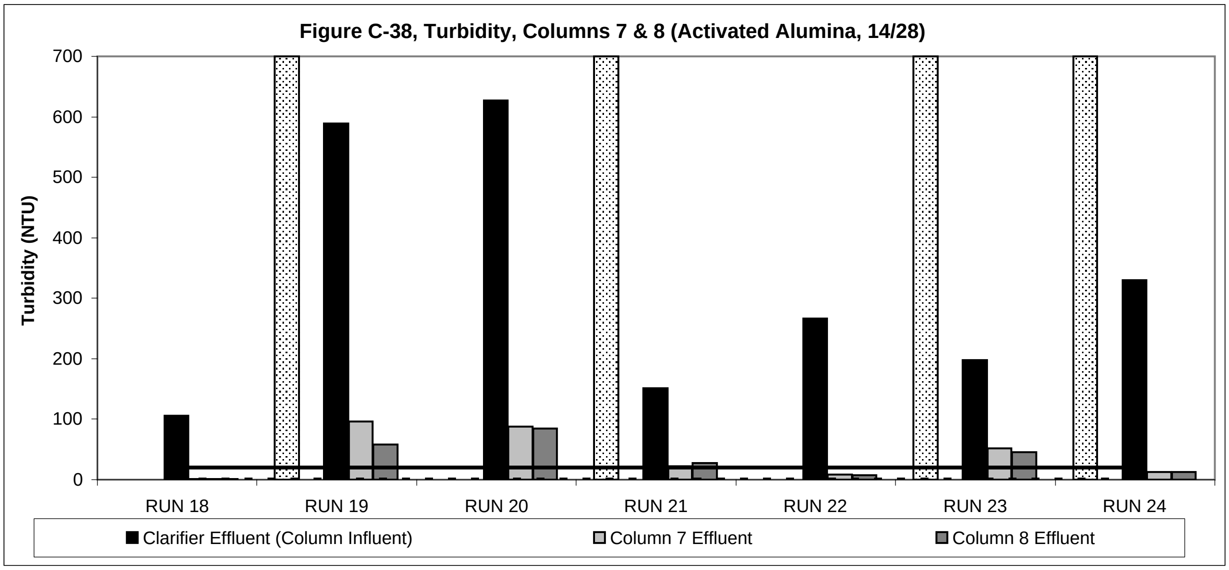


Figure C-38, Turbidity, Columns 7 & 8 (Activated Alumina, 14/28)
Turbidity (NTU)
700
600
500
400
300
200
100
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 7 Effluent
Column 8 Effluent

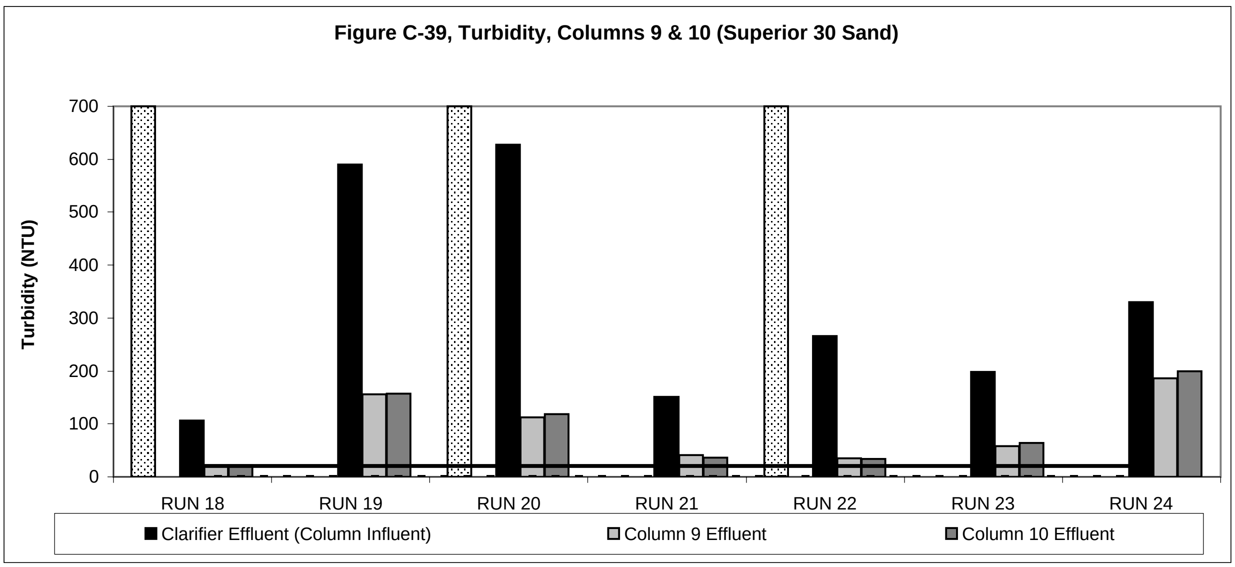


Figure C-39, Turbidity, Columns 9 & 10 (Superior 30 Sand)
Turbidity (NTU)
700
600
500
400
300
200
100
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 9 Effluent
Column 10 Effluent

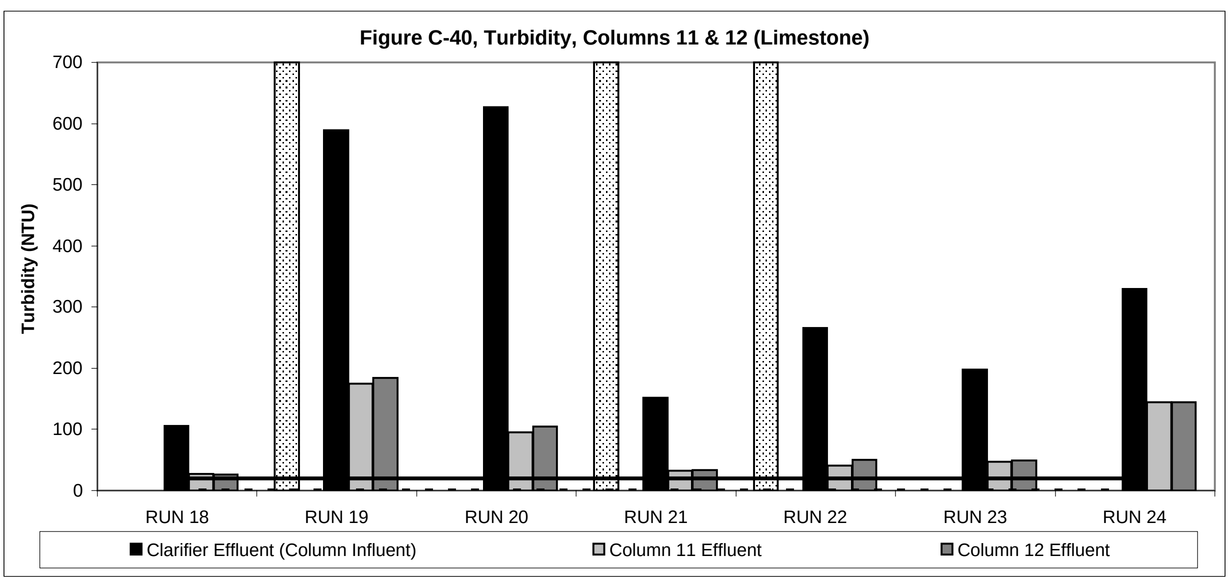


Figure C-40, Turbidity, Columns 11 & 12 (Limestone)
Turbidity (NTU)
700
600
500
400
300
200
100
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 11 Effluent
Column 12 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

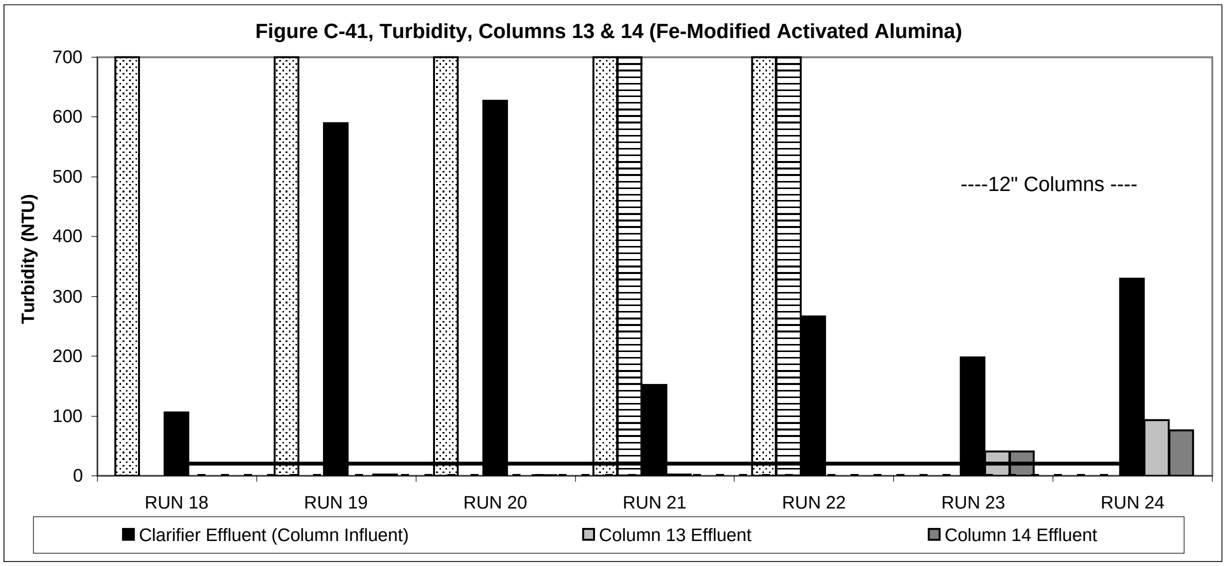


Figure C-41, Turbidity, Columns 13 & 14 (Fe-Modified Activated Alumina)
Turbidity (NTU)
700
600
500
400
300
200
100
0
----12" Columns ----
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 13 Effluent
Column 14 Effluent

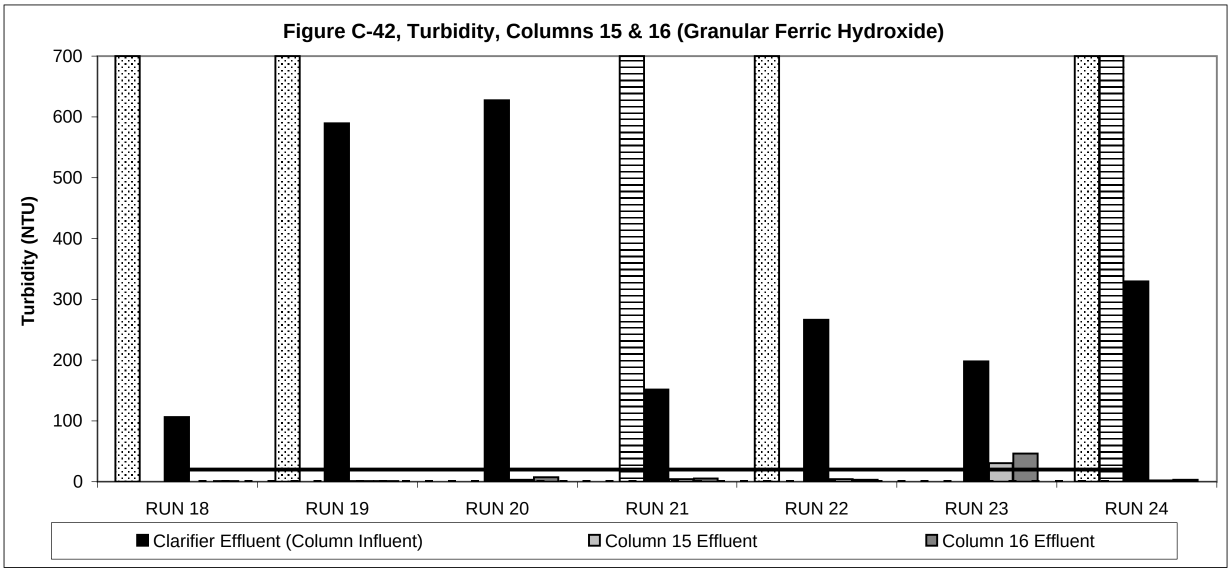


Figure C-42, Turbidity, Columns 15 & 16 (Granular Ferric Hydroxide)
Turbidity (NTU)
700
600
500
400
300
200
100
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 15 Effluent
Column 16 Effluent

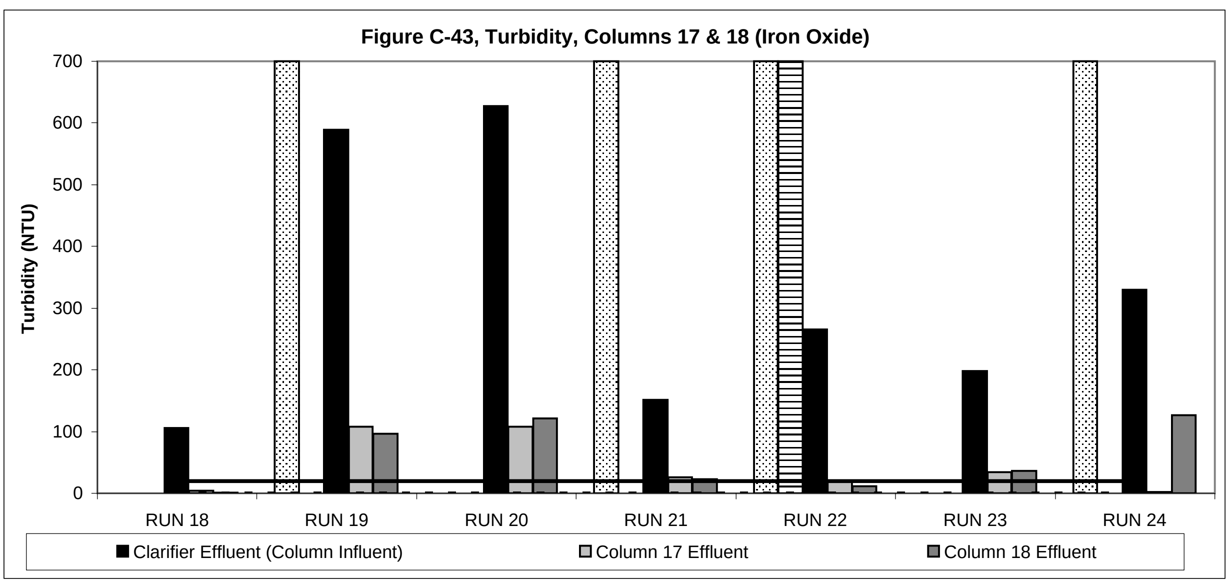


Figure C-43, Turbidity, Columns 17 & 18 (Iron Oxide)
Turbidity (NTU)
700
600
500
400
300
200
100
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 17 Effluent
Column 18 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

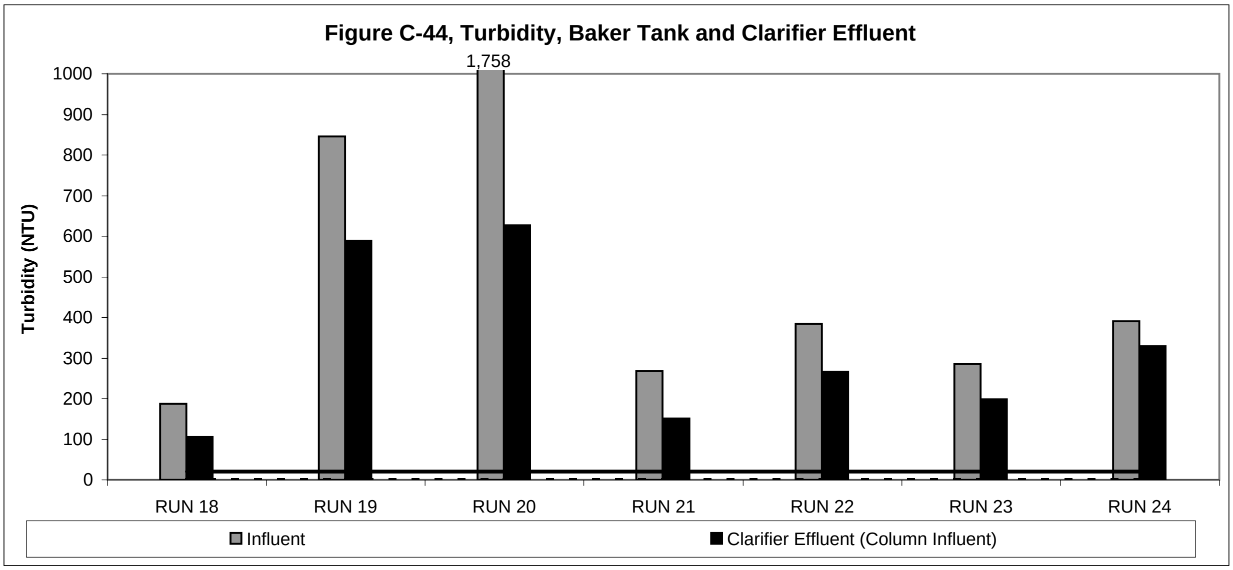


Figure C-44, Turbidity, Baker Tank and Clarifier Effluent
1,758
1000
900
800
700
600
500
400
300
200
100
0
Turbidity (NTU)
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Influent
Clarifier Effluent (Column Influent)

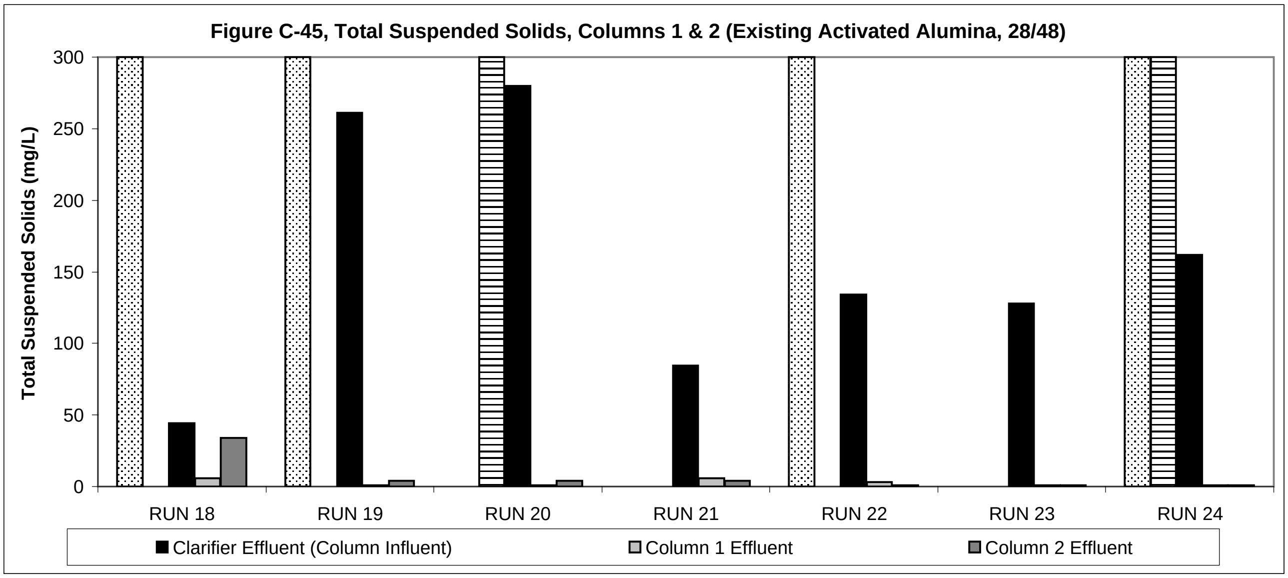


Figure C-45, Total Suspended Solids, Columns 1 & 2 (Existing Activated Alumina, 28/48)
300
250
200
150
100
50
0
Total Suspended Solids (mg/L)
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 1 Effluent
Column 2 Effluent

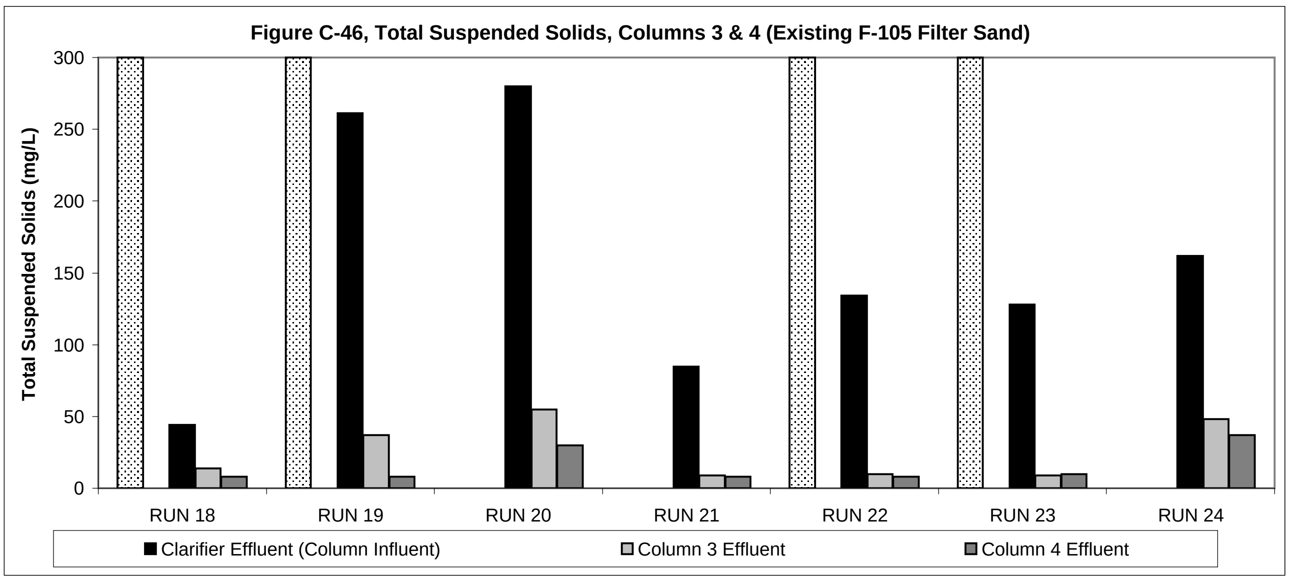


Figure C-46, Total Suspended Solids, Columns 3 & 4 (Existing F-105 Filter Sand)
300
250
200
150
100
50
0
Total Suspended Solids (mg/L)
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 3 Effluent
Column 4 Effluent

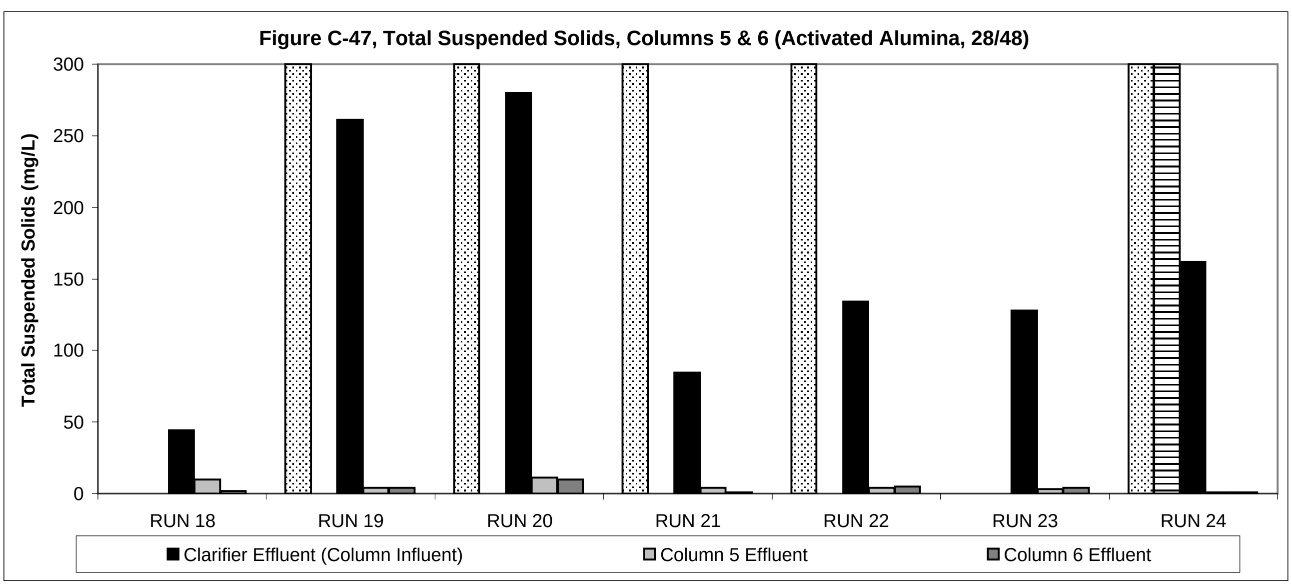


Figure C-47, Total Suspended Solids, Columns 5 & 6 (Activated Alumina, 28/48)
300
250
200
150
100
50
0
Total Suspended Solids (mg/L)
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 5 Effluent
Column 6 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

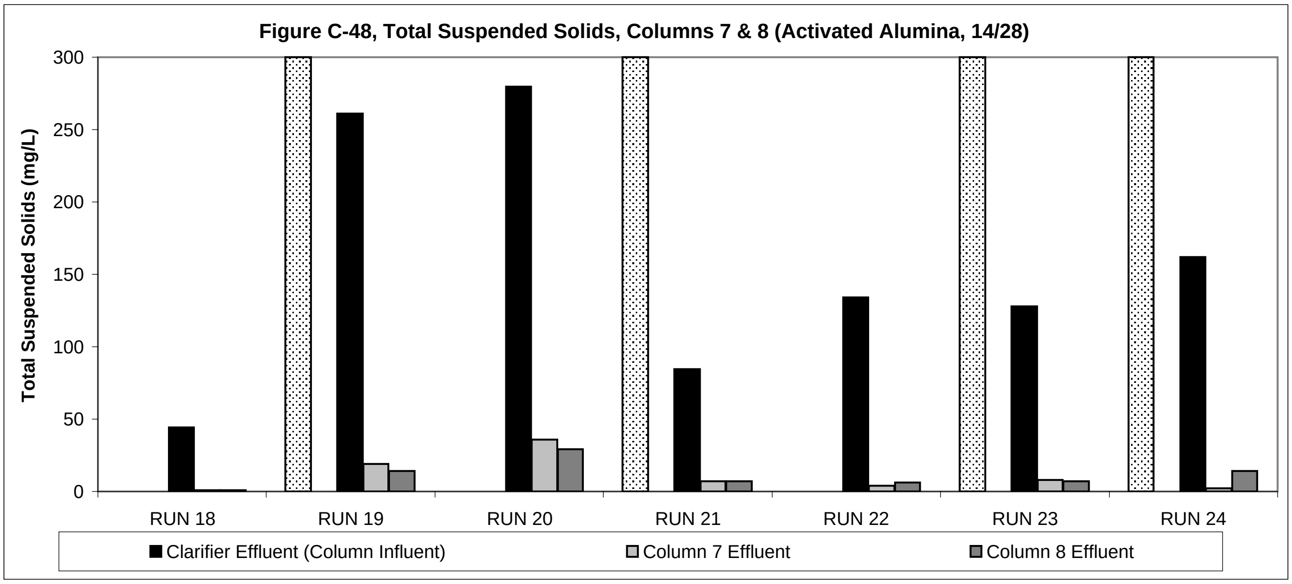


Figure C-48, Total Suspended Solids, Columns 7 & 8 (Activated Alumina, 14/28)
Total Suspended Solids (mg/L)
300
250
200
150
100
50
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 7 Effluent
Column 8 Effluent

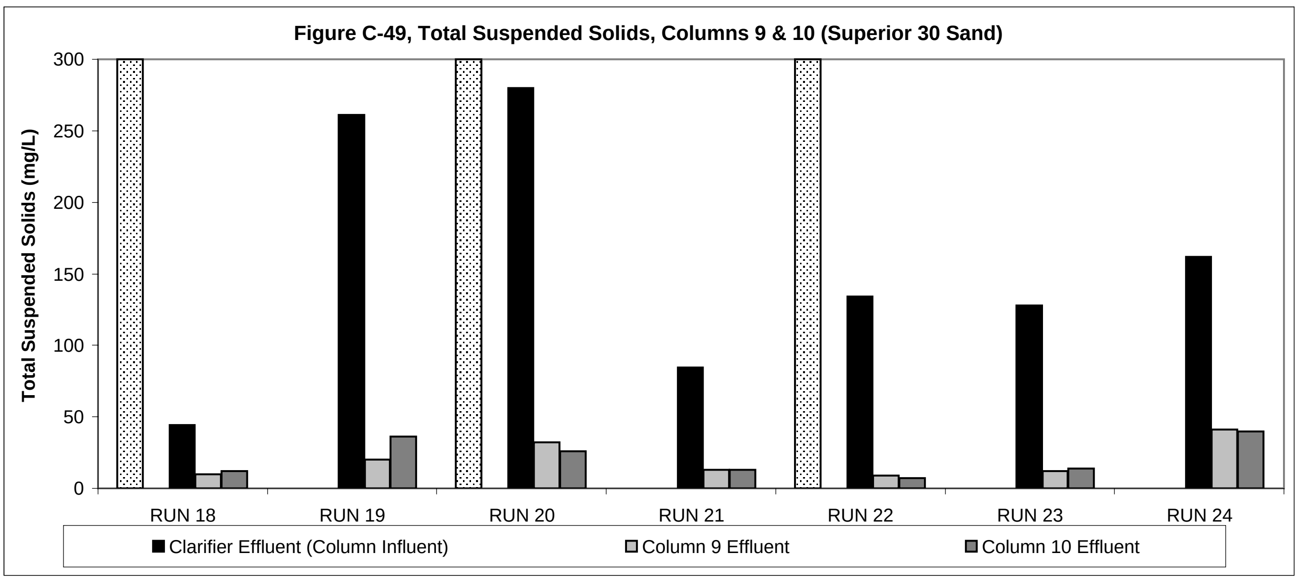


Figure C-49, Total Suspended Solids, Columns 9 & 10 (Superior 30 Sand)
Total Suspended Solids (mg/L)
300
250
200
150
100
50
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 9 Effluent
Column 10 Effluent

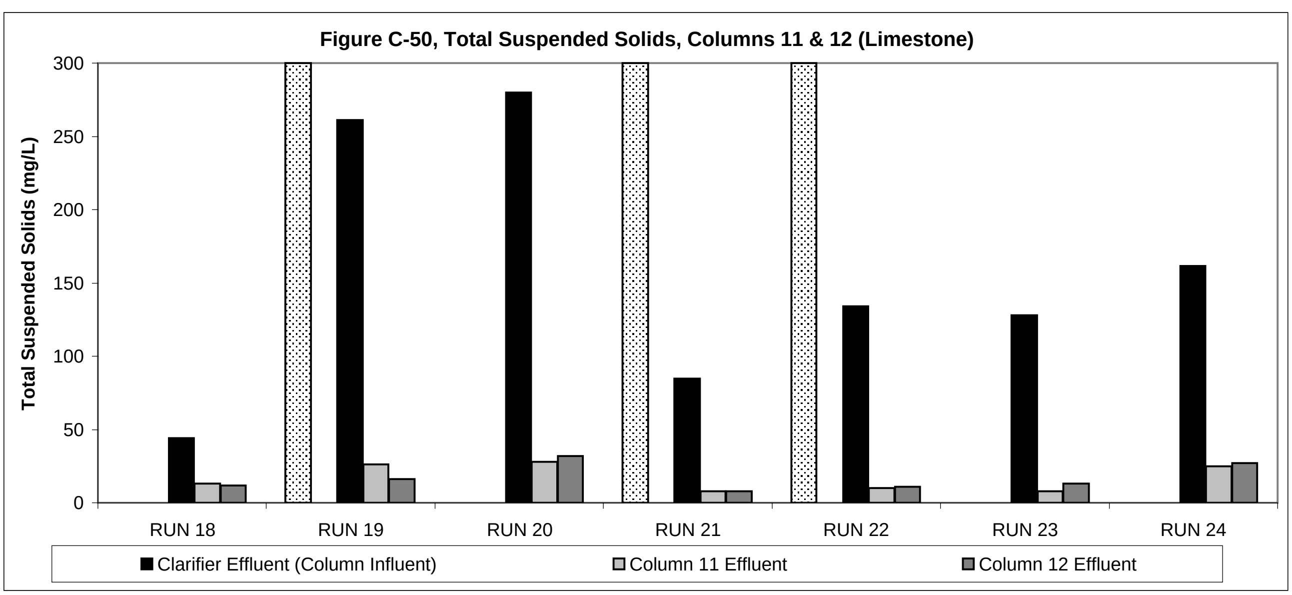
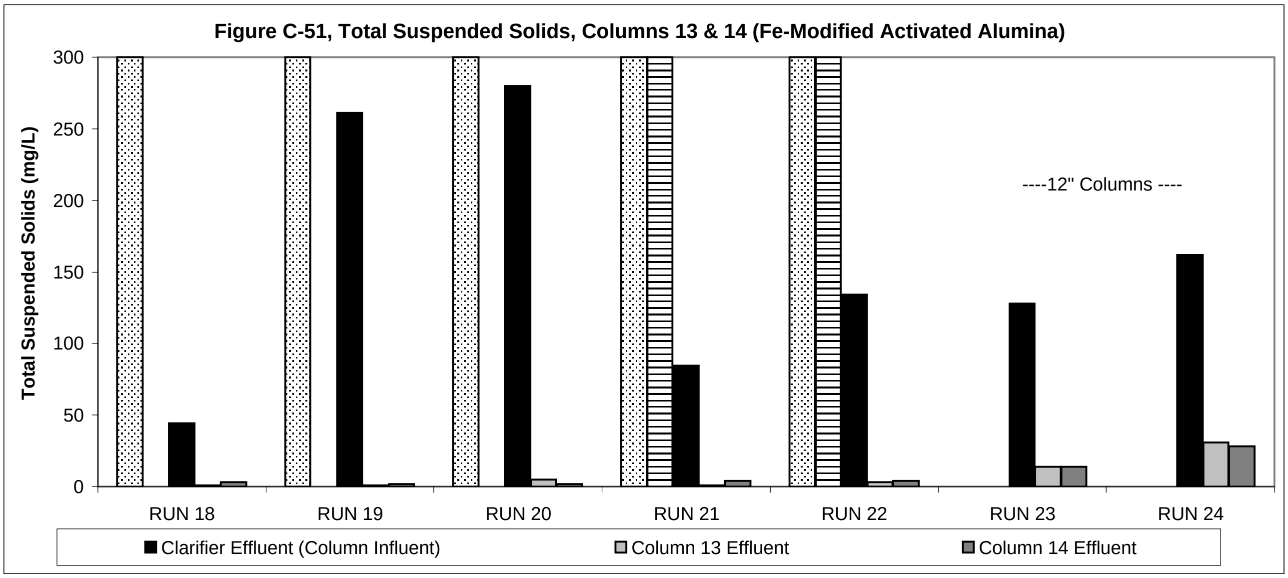
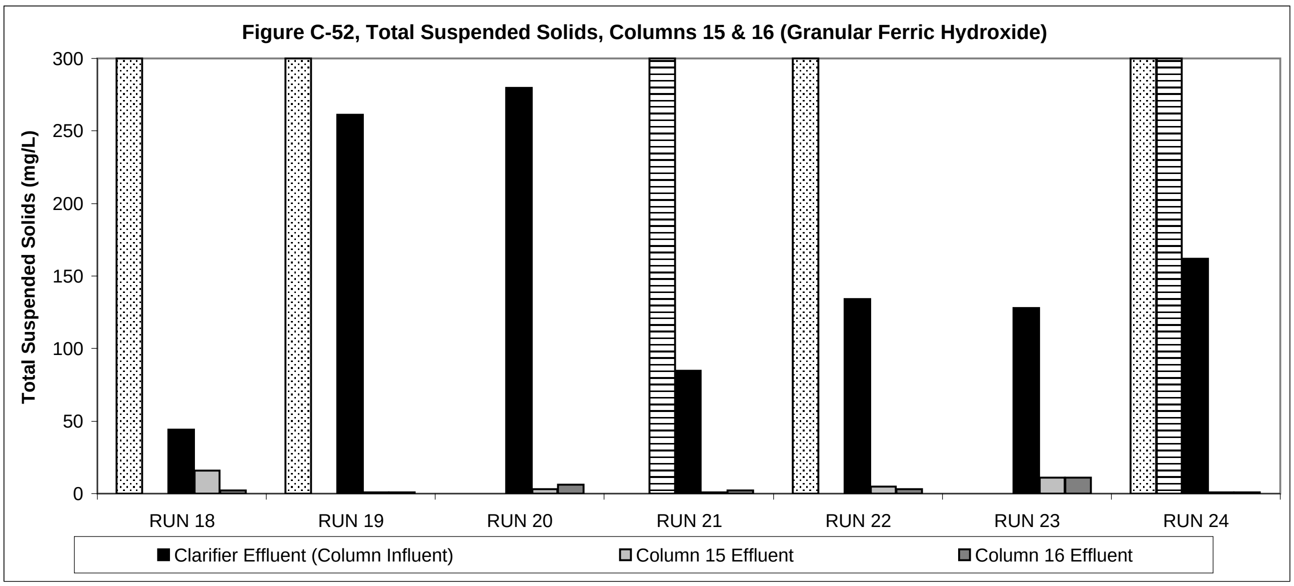
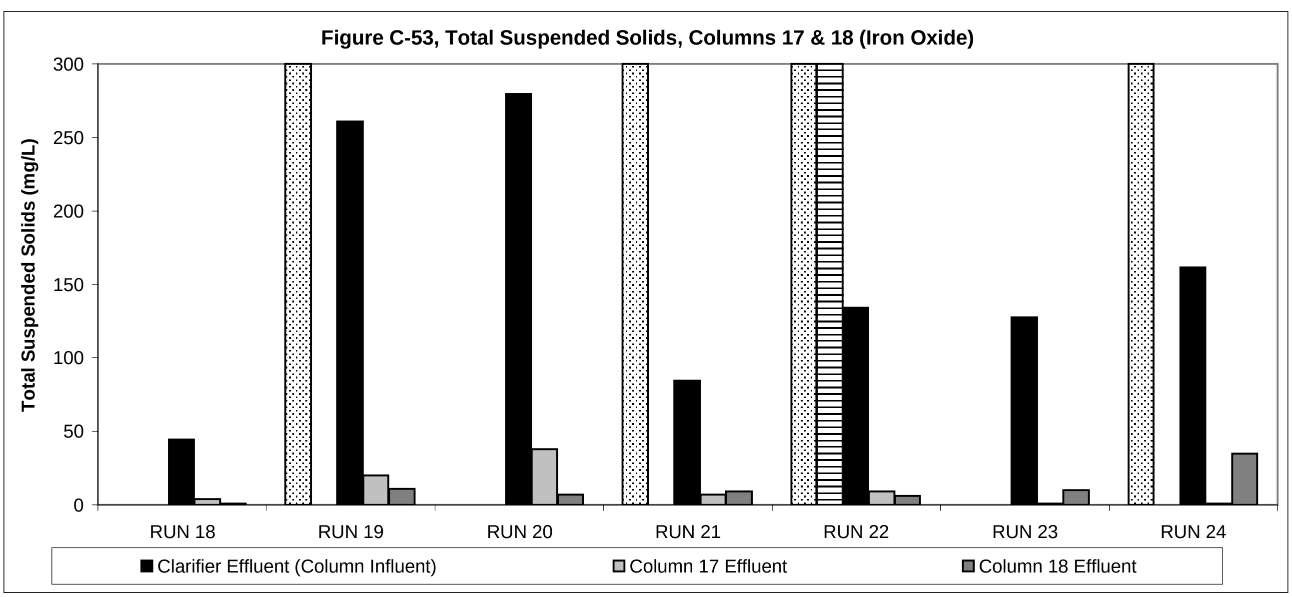


Figure C-50, Total Suspended Solids, Columns 11 & 12 (Limestone)
Total Suspended Solids (mg/L)
300
250
200
150
100
50
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 11 Effluent
Column 12 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

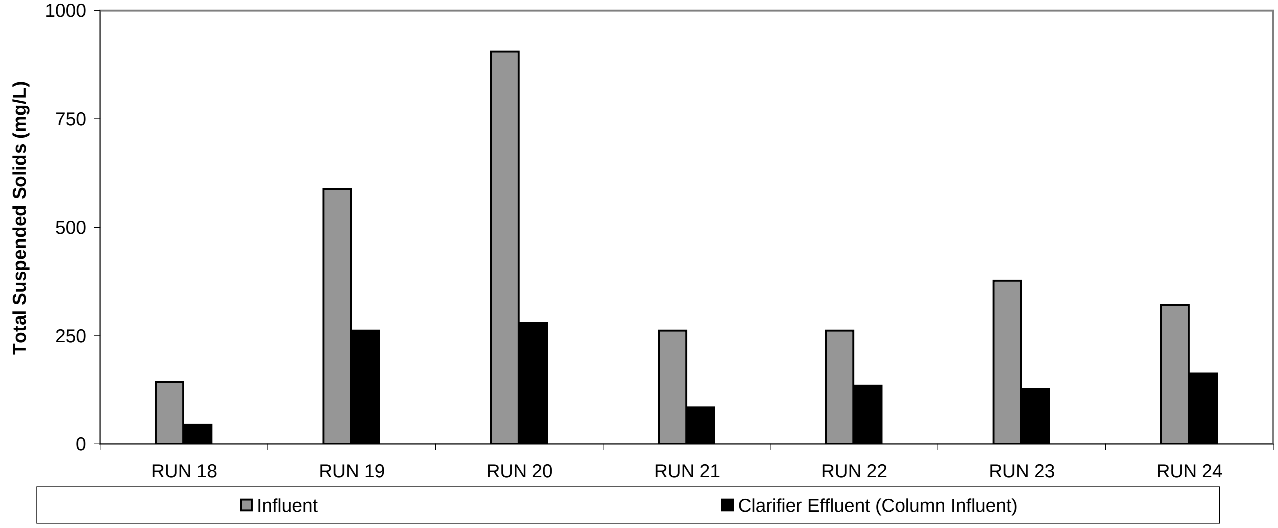






New Sand Cap — New Media — Reg Lmt — Rpt Lmt

Figure C-54, Total Suspended Solids, Baker Tank and Clarifier Effluent



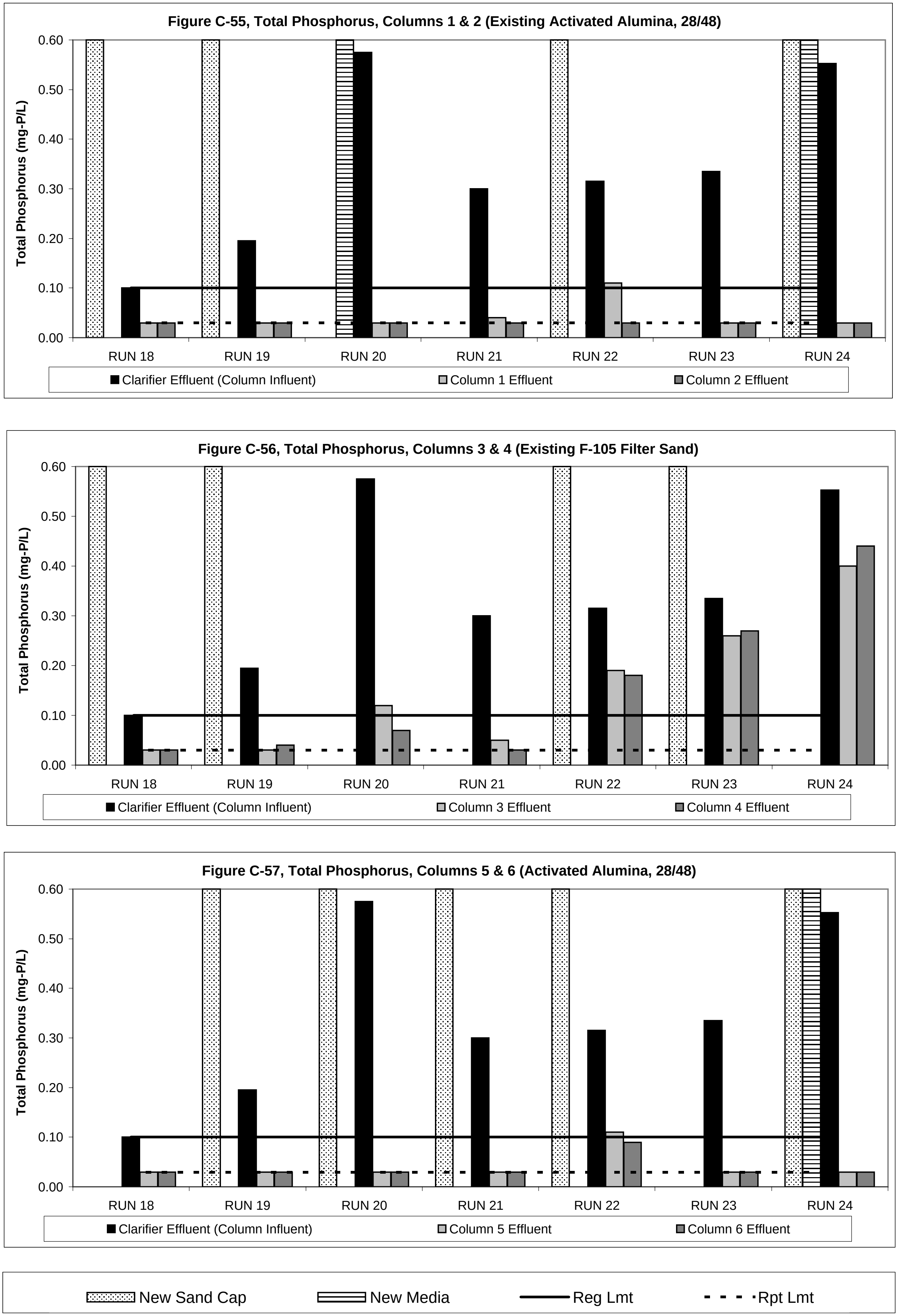


Figure C-55, Total Phosphorus, Columns 1 & 2 (Existing Activated Alumina, 28/48)
Total Phosphorus (mg-P/L)
0.00
0.10
0.20
0.30
0.40
0.50
0.60
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 1 Effluent
Column 2 Effluent
Figure C-56, Total Phosphorus, Columns 3 & 4 (Existing F-105 Filter Sand)
Total Phosphorus (mg-P/L)
0.00
0.10
0.20
0.30
0.40
0.50
0.60
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 3 Effluent
Column 4 Effluent
Figure C-57, Total Phosphorus, Columns 5 & 6 (Activated Alumina, 28/48)
Total Phosphorus (mg-P/L)
0.00
0.10
0.20
0.30
0.40
0.50
0.60
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 5 Effluent
Column 6 Effluent
New Sand Cap
New Media
Reg Lmt
Rpt Lmt

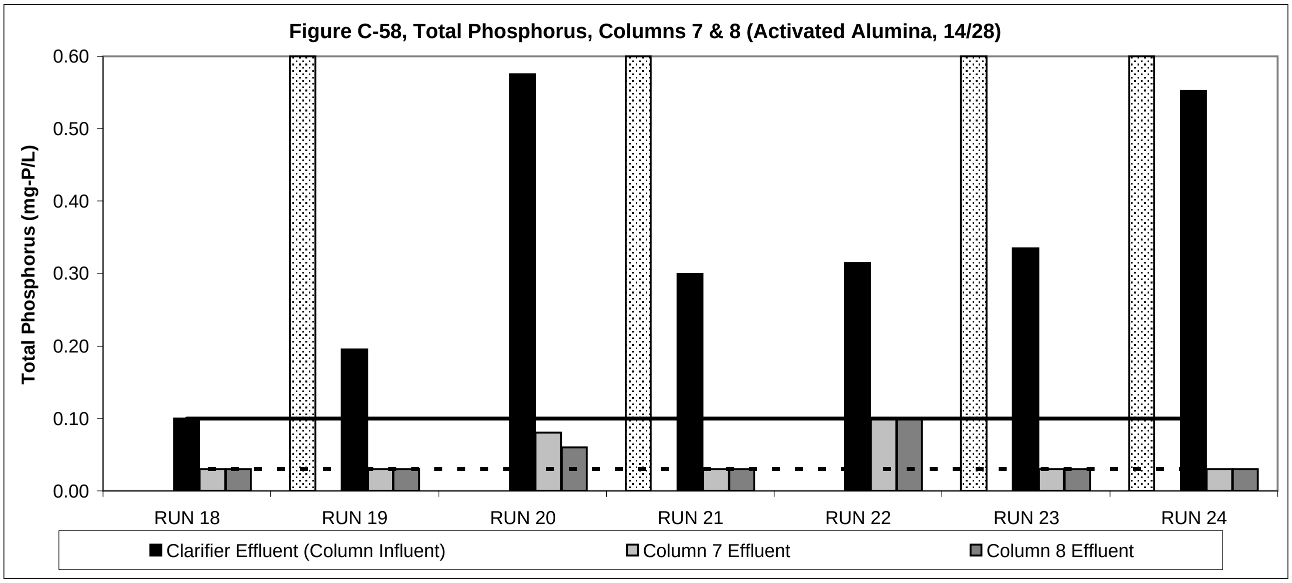


Figure C-58, Total Phosphorus, Columns 7 & 8 (Activated Alumina, 14/28)
Total Phosphorus (mg-P/L)
0.60
0.50
0.40
0.30
0.20
0.10
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 7 Effluent
Column 8 Effluent

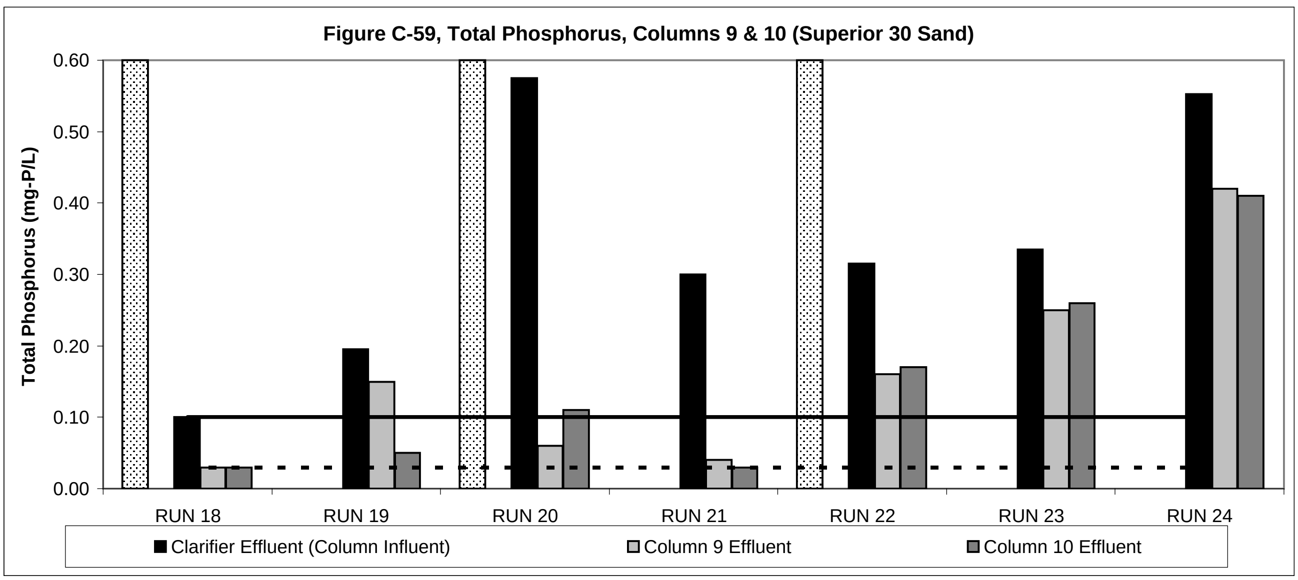


Figure C-59, Total Phosphorus, Columns 9 & 10 (Superior 30 Sand)
Total Phosphorus (mg-P/L)
0.60
0.50
0.40
0.30
0.20
0.10
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 9 Effluent
Column 10 Effluent

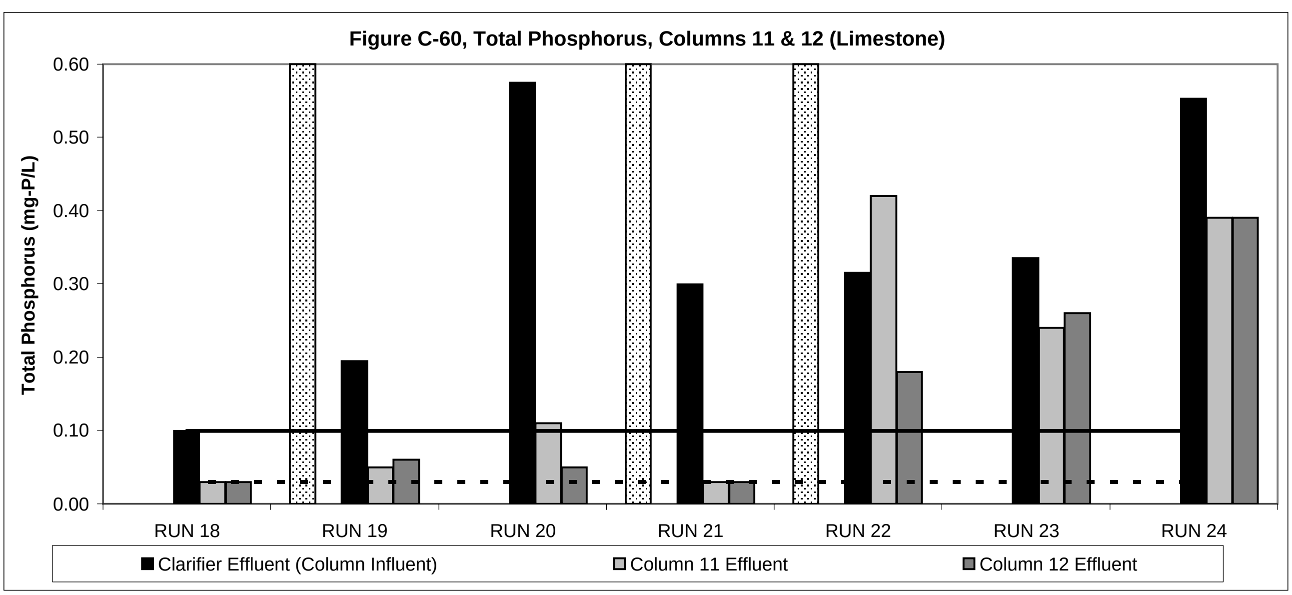
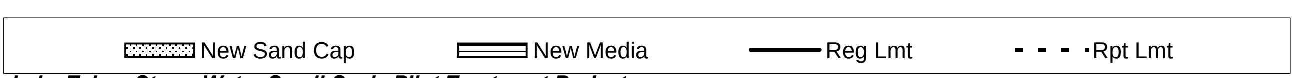


Figure C-60, Total Phosphorus, Columns 11 & 12 (Limestone)
Total Phosphorus (mg-P/L)
0.60
0.50
0.40
0.30
0.20
0.10
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 11 Effluent
Column 12 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

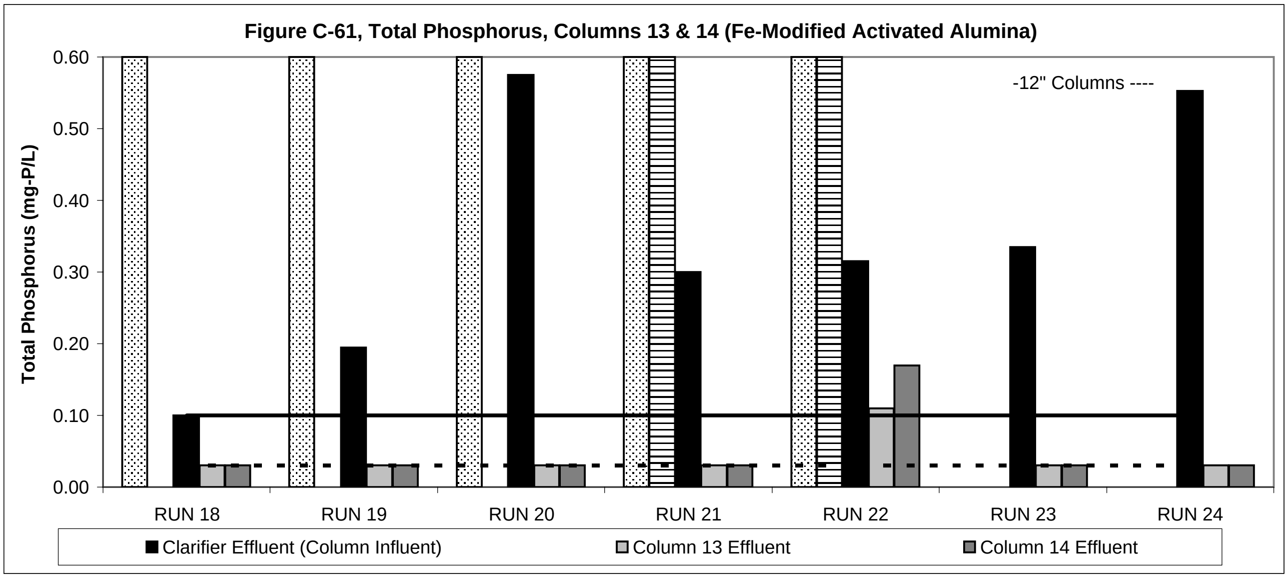


Figure C-61, Total Phosphorus, Columns 13 & 14 (Fe-Modified Activated Alumina)
-12" Columns ----
Total Phosphorus (mg-P/L)
0.60
0.50
0.40
0.30
0.20
0.10
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 13 Effluent
Column 14 Effluent

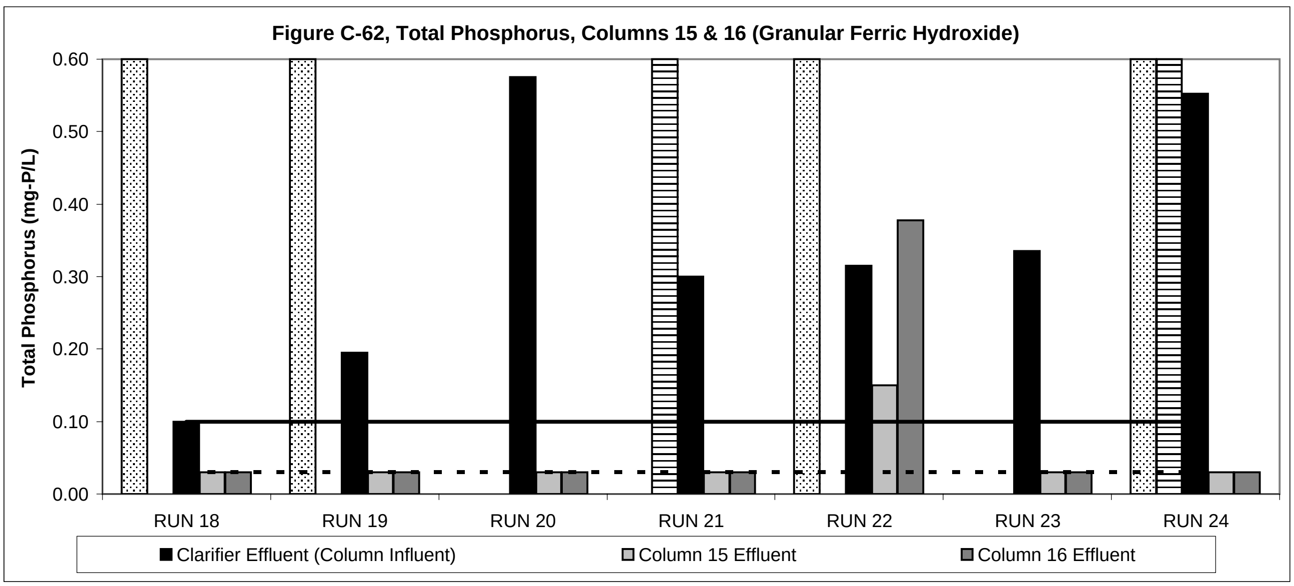


Figure C-62, Total Phosphorus, Columns 15 & 16 (Granular Ferric Hydroxide)
Total Phosphorus (mg-P/L)
0.60
0.50
0.40
0.30
0.20
0.10
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 15 Effluent
Column 16 Effluent

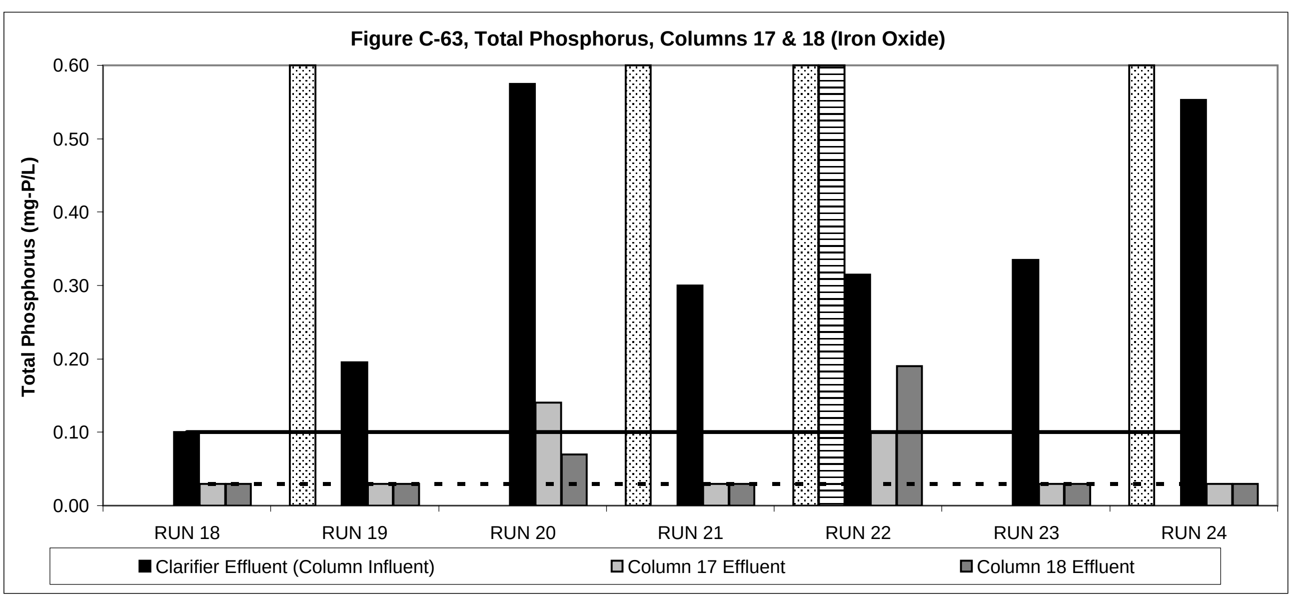


Figure C-63, Total Phosphorus, Columns 17 & 18 (Iron Oxide)
Total Phosphorus (mg-P/L)
0.60
0.50
0.40
0.30
0.20
0.10
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 17 Effluent
Column 18 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

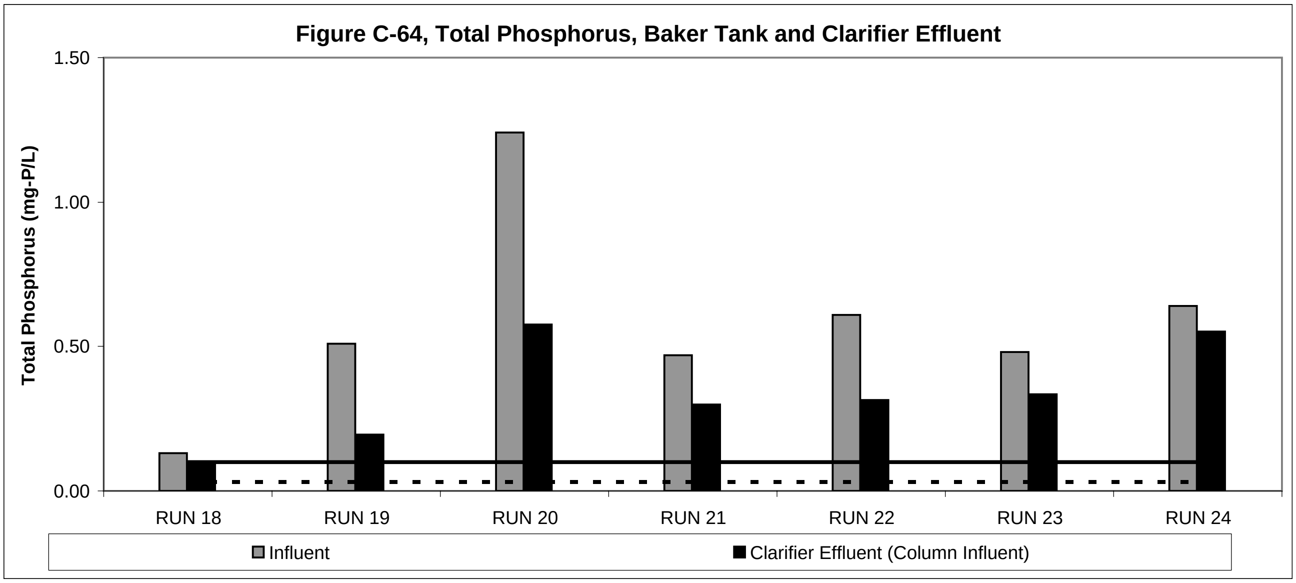


Figure C-64, Total Phosphorus, Baker Tank and Clarifier Effluent
Total Phosphorus (mg-P/L)
1.50
1.00
0.50
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Influent
Clarifier Effluent (Column Influent)

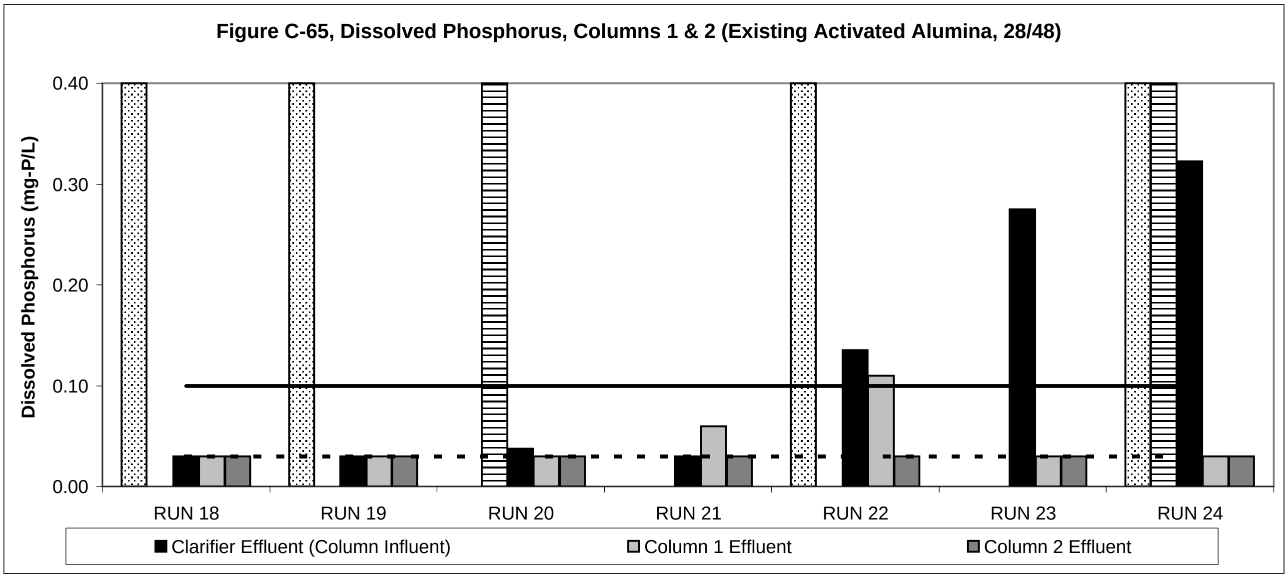


Figure C-65, Dissolved Phosphorus, Columns 1 & 2 (Existing Activated Alumina, 28/48)
Dissolved Phosphorus (mg-P/L)
0.40
0.30
0.20
0.10
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 1 Effluent
Column 2 Effluent

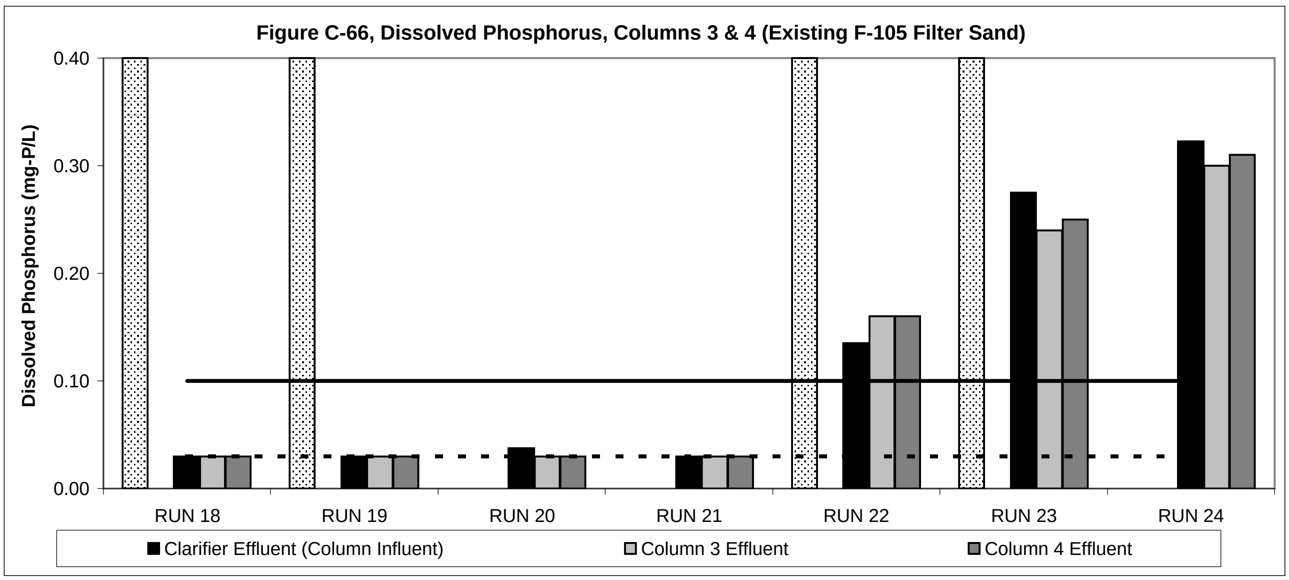


Figure C-66, Dissolved Phosphorus, Columns 3 & 4 (Existing F-105 Filter Sand)
Dissolved Phosphorus (mg-P/L)
0.40
0.30
0.20
0.10
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 3 Effluent
Column 4 Effluent

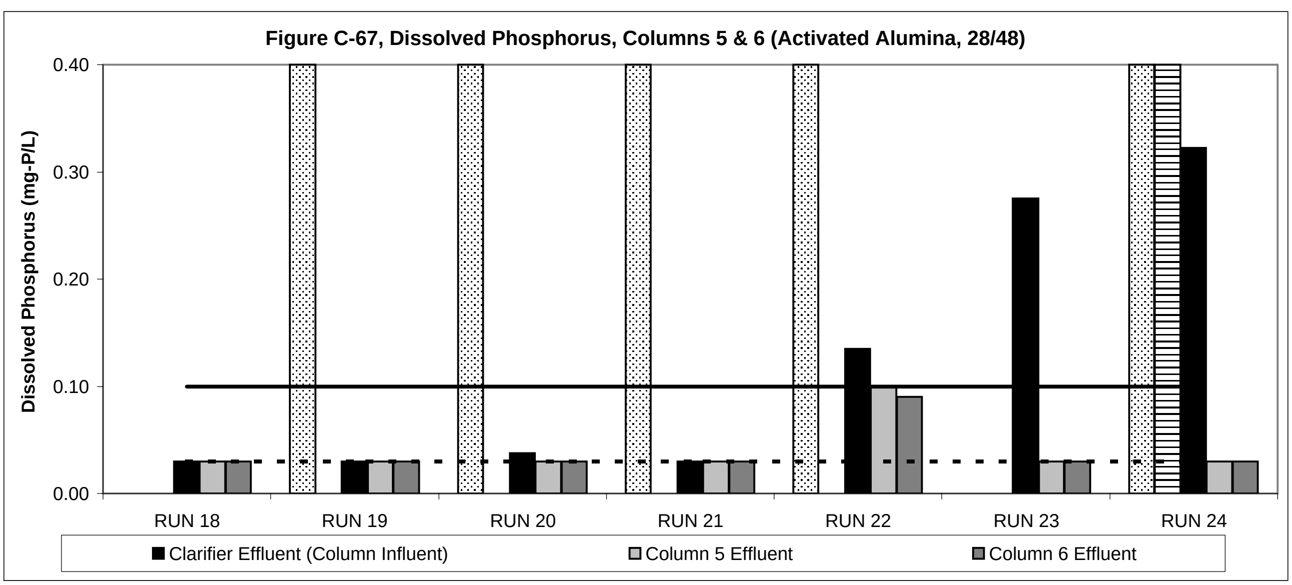


Figure C-67, Dissolved Phosphorus, Columns 5 & 6 (Activated Alumina, 28/48)
Dissolved Phosphorus (mg-P/L)
0.40
0.30
0.20
0.10
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 5 Effluent
Column 6 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

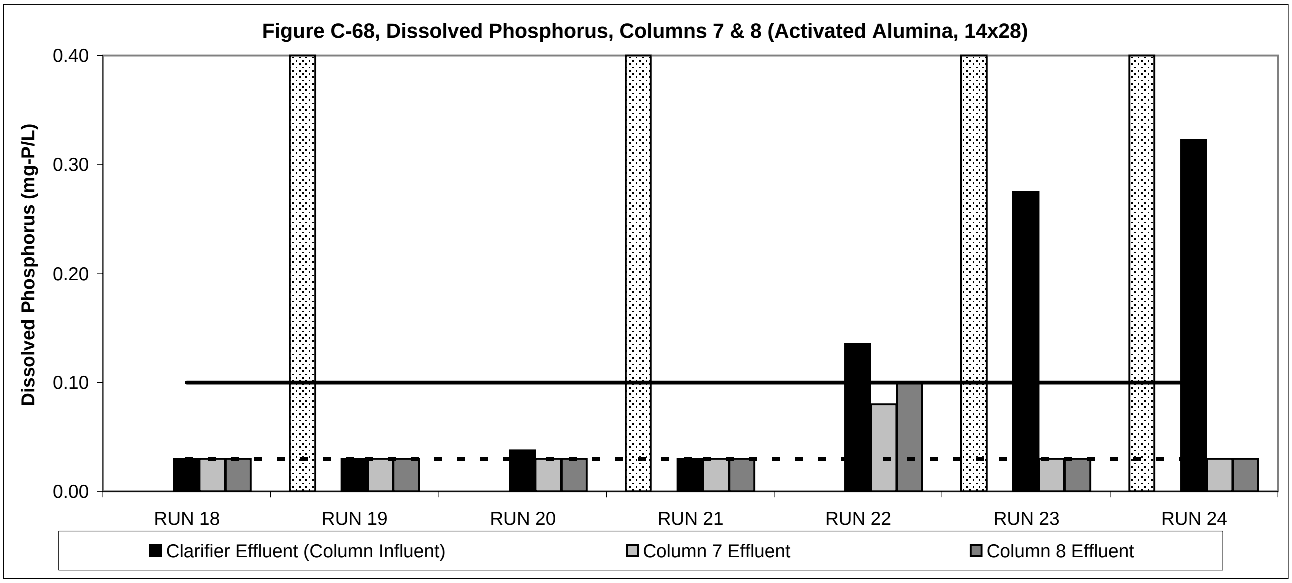


Figure C-68, Dissolved Phosphorus, Columns 7 & 8 (Activated Alumina, 14x28)
Dissolved Phosphorus (mg-P/L)
0.40
0.30
0.20
0.10
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 7 Effluent
Column 8 Effluent

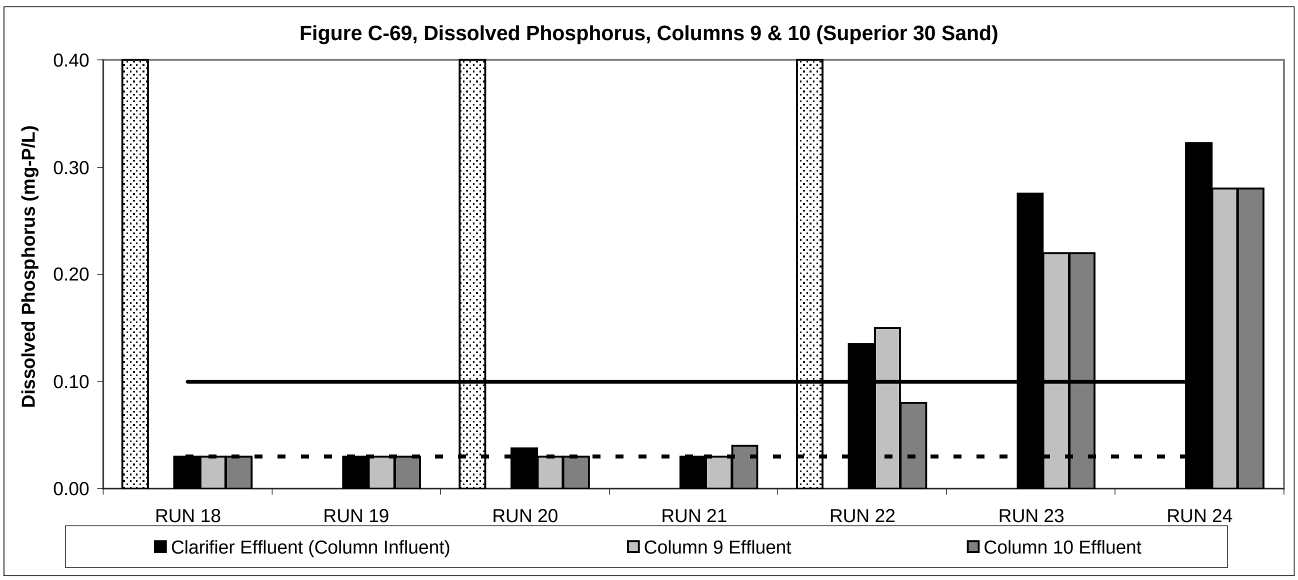


Figure C-69, Dissolved Phosphorus, Columns 9 & 10 (Superior 30 Sand)
Dissolved Phosphorus (mg-P/L)
0.40
0.30
0.20
0.10
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 9 Effluent
Column 10 Effluent

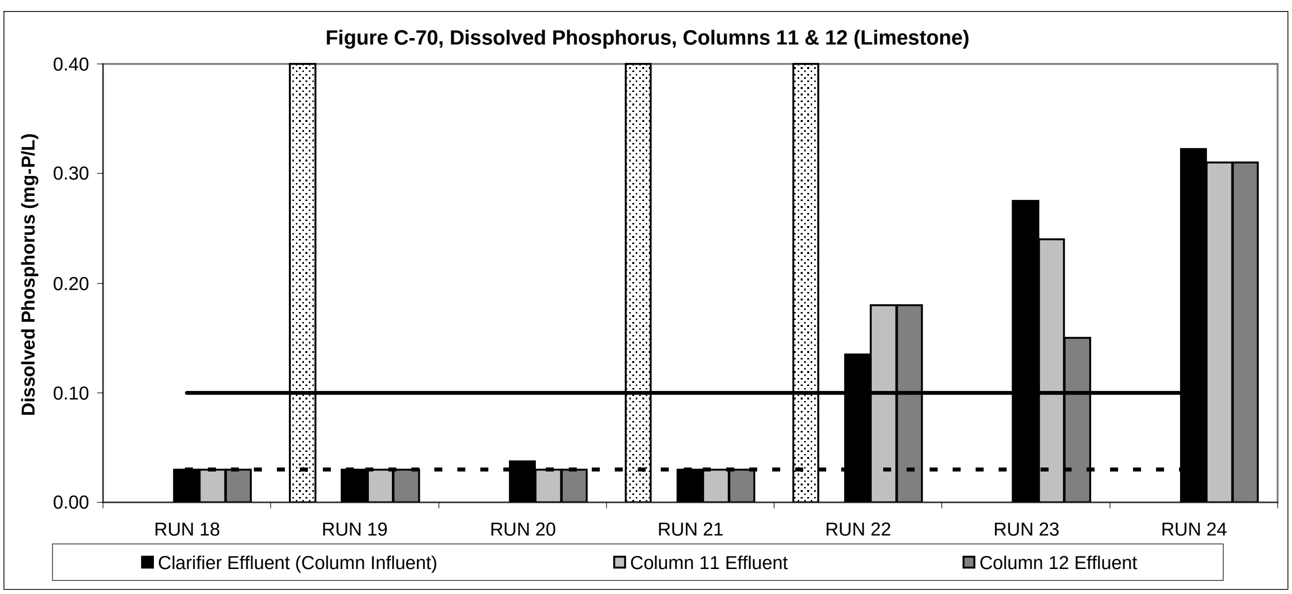


Figure C-70, Dissolved Phosphorus, Columns 11 & 12 (Limestone)
Dissolved Phosphorus (mg-P/L)
0.40
0.30
0.20
0.10
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 11 Effluent
Column 12 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

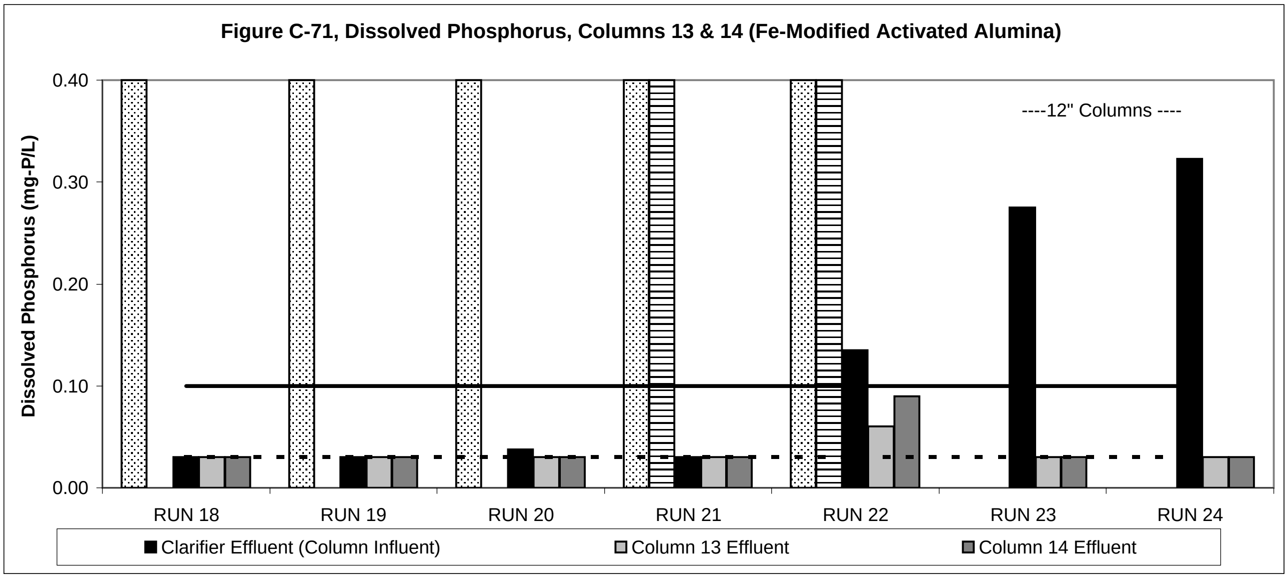


Figure C-71, Dissolved Phosphorus, Columns 13 & 14 (Fe-Modified Activated Alumina)
Dissolved Phosphorus (mg-P/L)
0.40
0.30
0.20
0.10
0.00
----12" Columns ----
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 13 Effluent
Column 14 Effluent

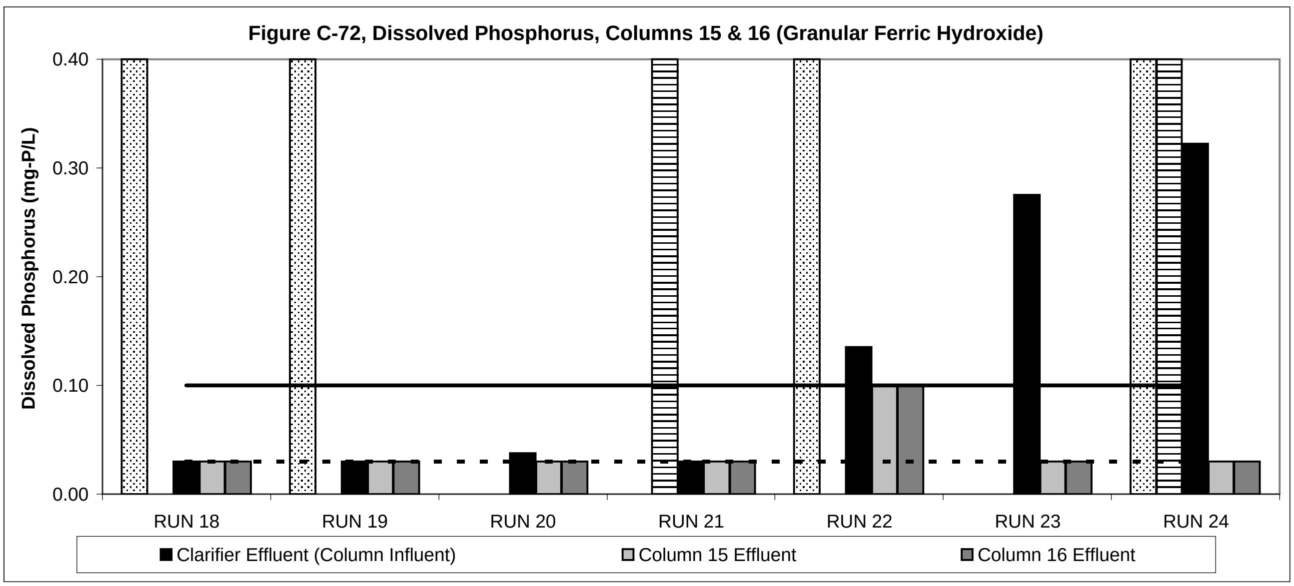


Figure C-72, Dissolved Phosphorus, Columns 15 & 16 (Granular Ferric Hydroxide)
Dissolved Phosphorus (mg-P/L)
0.40
0.30
0.20
0.10
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 15 Effluent
Column 16 Effluent

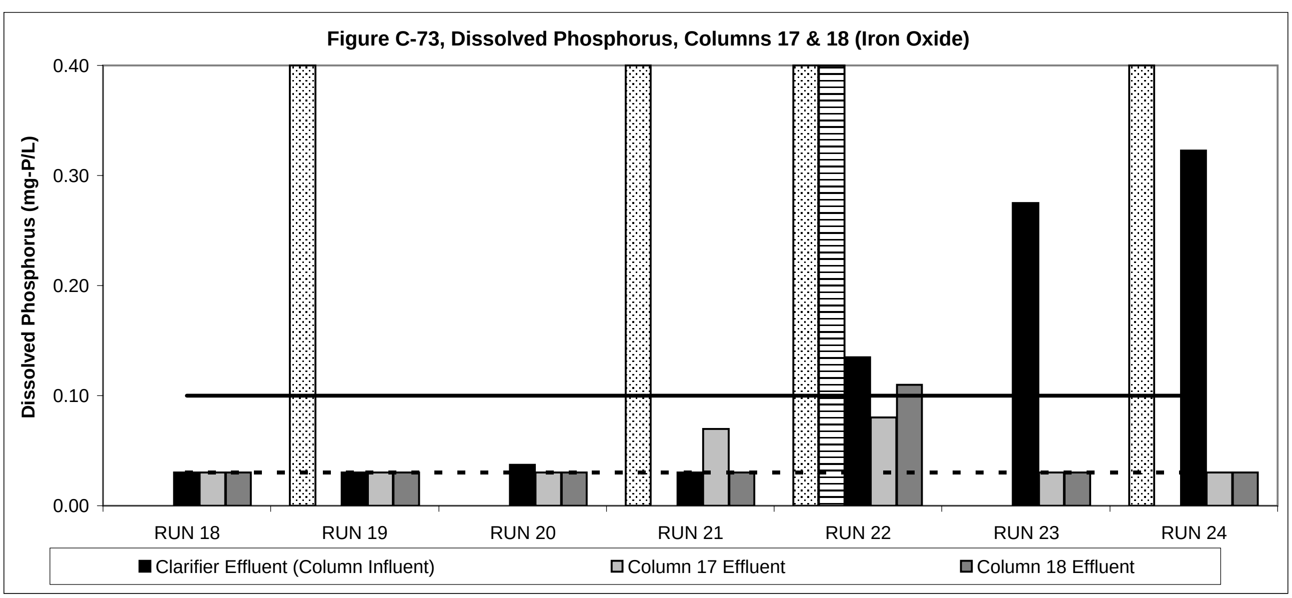
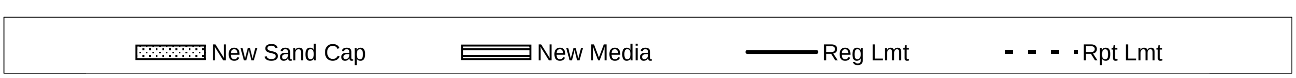


Figure C-73, Dissolved Phosphorus, Columns 17 & 18 (Iron Oxide)
Dissolved Phosphorus (mg-P/L)
0.40
0.30
0.20
0.10
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 17 Effluent
Column 18 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

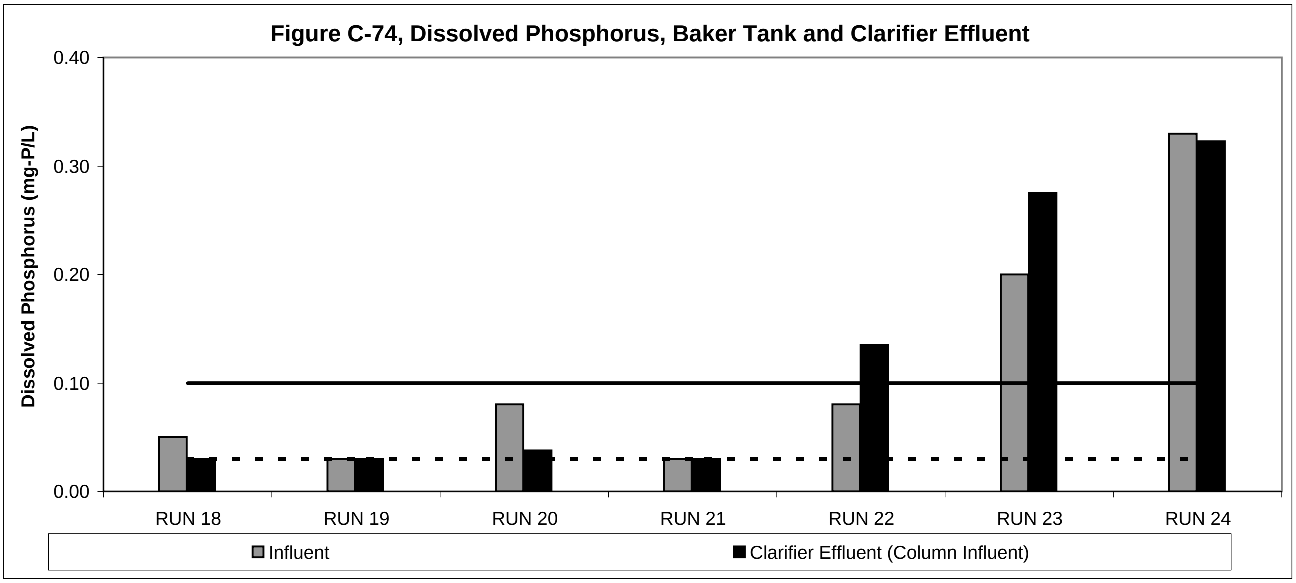


Figure C-74, Dissolved Phosphorus, Baker Tank and Clarifier Effluent
Dissolved Phosphorus (mg-P/L)
0.40
0.30
0.20
0.10
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Influent
Clarifier Effluent (Column Influent)

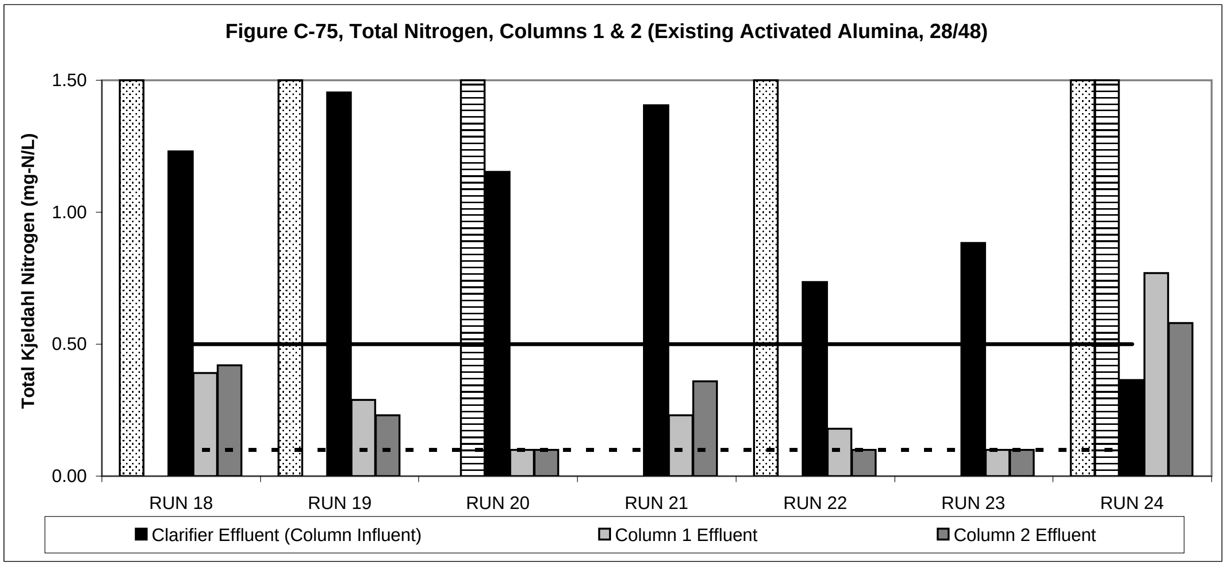


Figure C-75, Total Nitrogen, Columns 1 & 2 (Existing Activated Alumina, 28/48)
Total Kjeldahl Nitrogen (mg-N/L)
1.50
1.00
0.50
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 1 Effluent
Column 2 Effluent

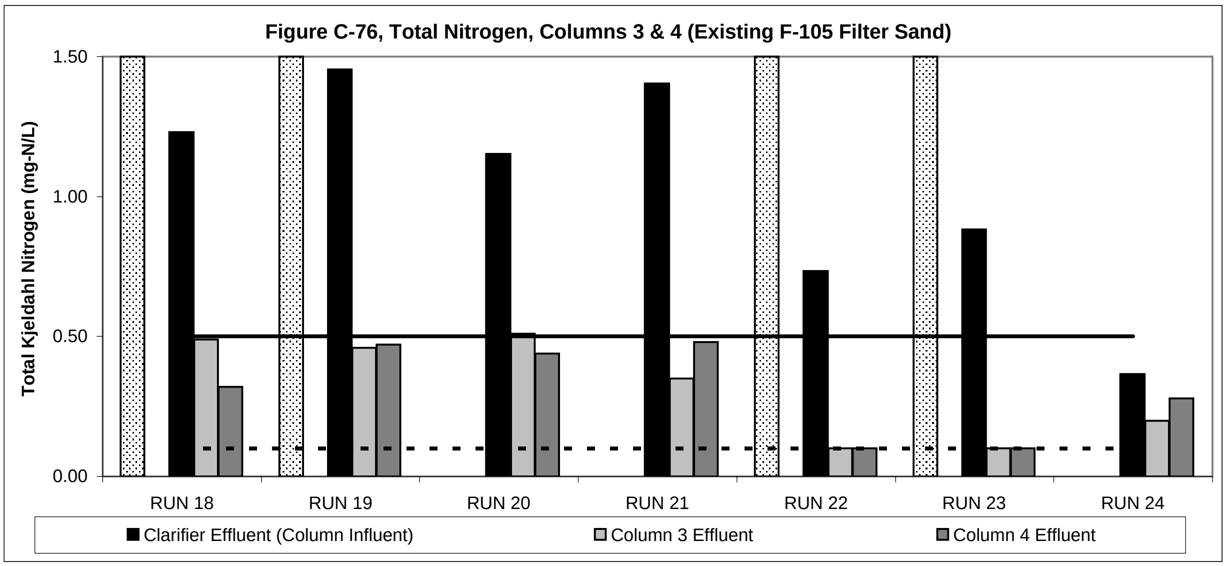


Figure C-76, Total Nitrogen, Columns 3 & 4 (Existing F-105 Filter Sand)
Total Kjeldahl Nitrogen (mg-N/L)
1.50
1.00
0.50
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 3 Effluent
Column 4 Effluent

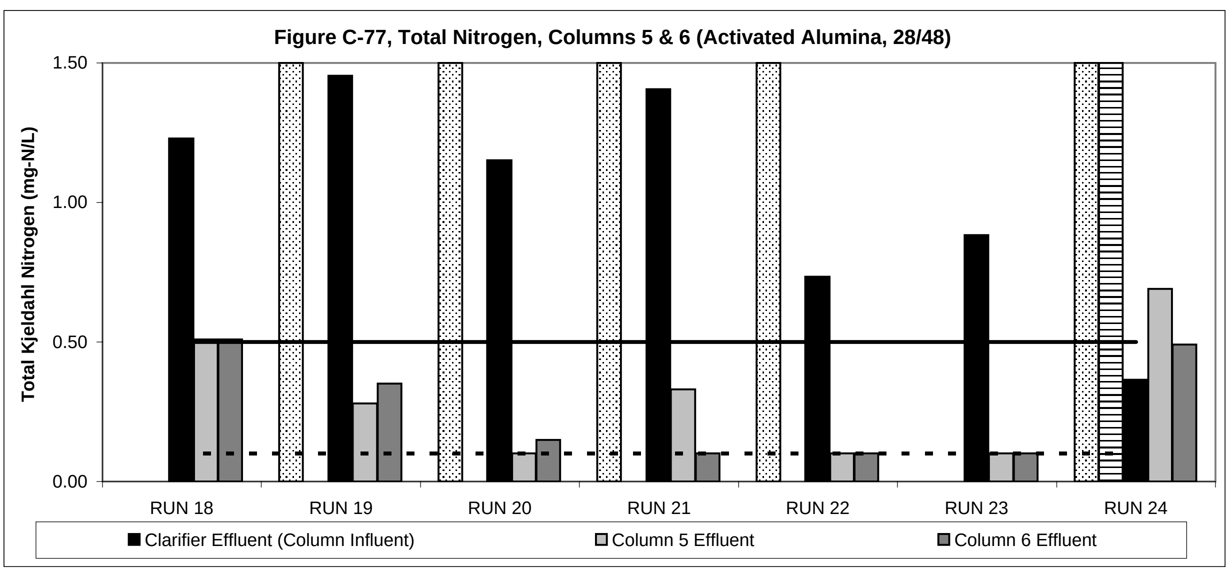


Figure C-77, Total Nitrogen, Columns 5 & 6 (Activated Alumina, 28/48)
Total Kjeldahl Nitrogen (mg-N/L)
1.50
1.00
0.50
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 5 Effluent
Column 6 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

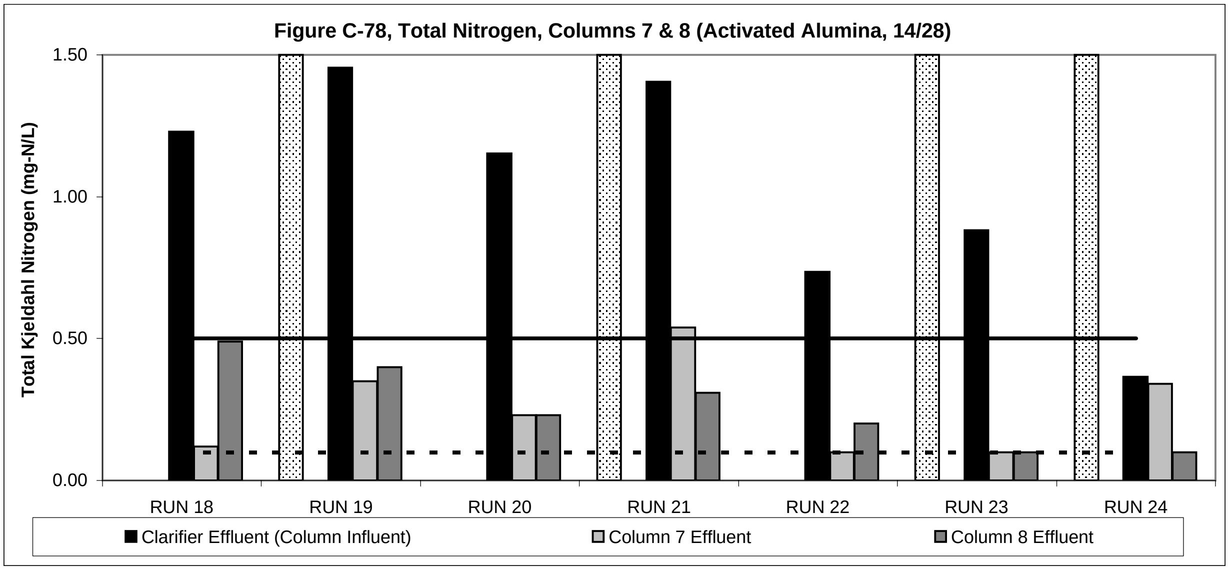


Figure C-78, Total Nitrogen, Columns 7 & 8 (Activated Alumina, 14/28)
Total Kjeldahl Nitrogen (mg-N/L)
1.50
1.00
0.50
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 7 Effluent
Column 8 Effluent

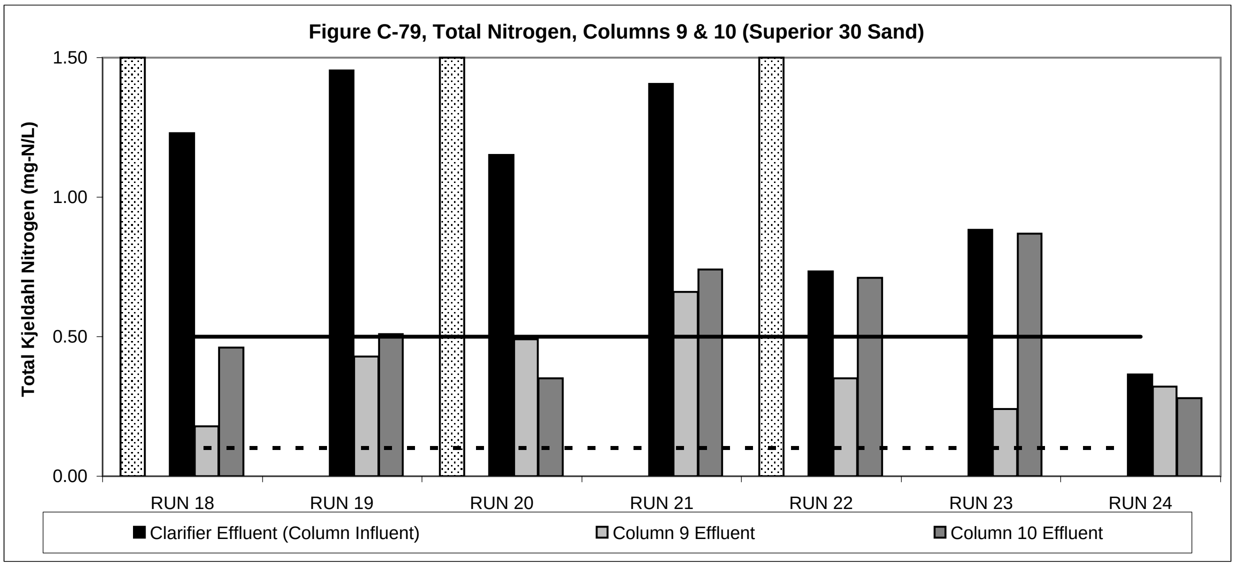


Figure C-79, Total Nitrogen, Columns 9 & 10 (Superior 30 Sand)
Total Kjeldahl Nitrogen (mg-N/L)
1.50
1.00
0.50
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 9 Effluent
Column 10 Effluent

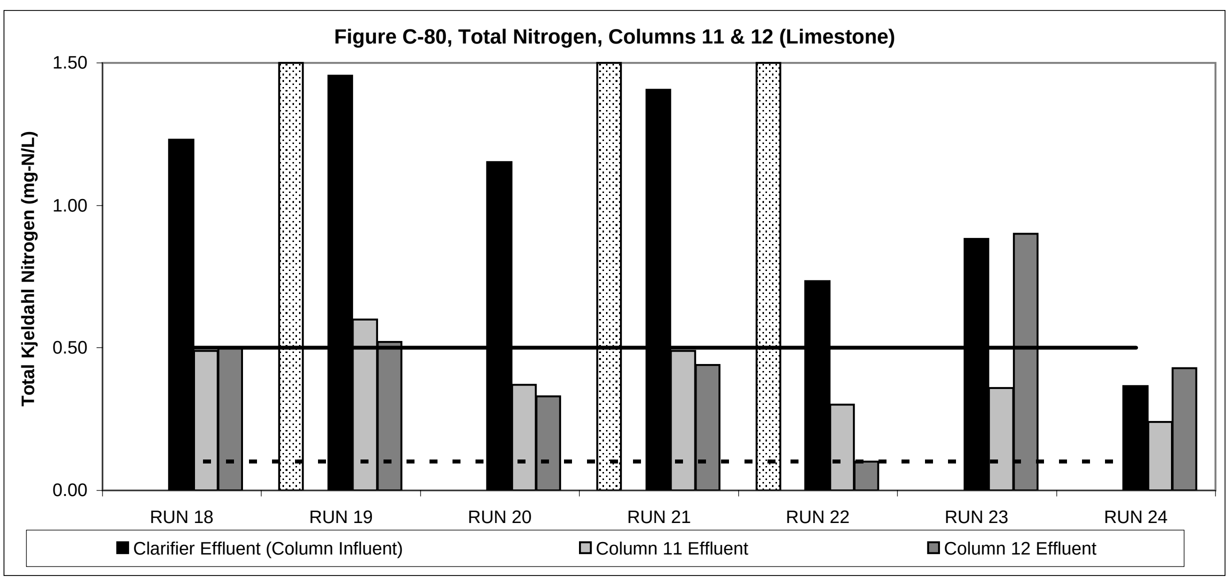


Figure C-80, Total Nitrogen, Columns 11 & 12 (Limestone)
Total Kjeldahl Nitrogen (mg-N/L)
1.50
1.00
0.50
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 11 Effluent
Column 12 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

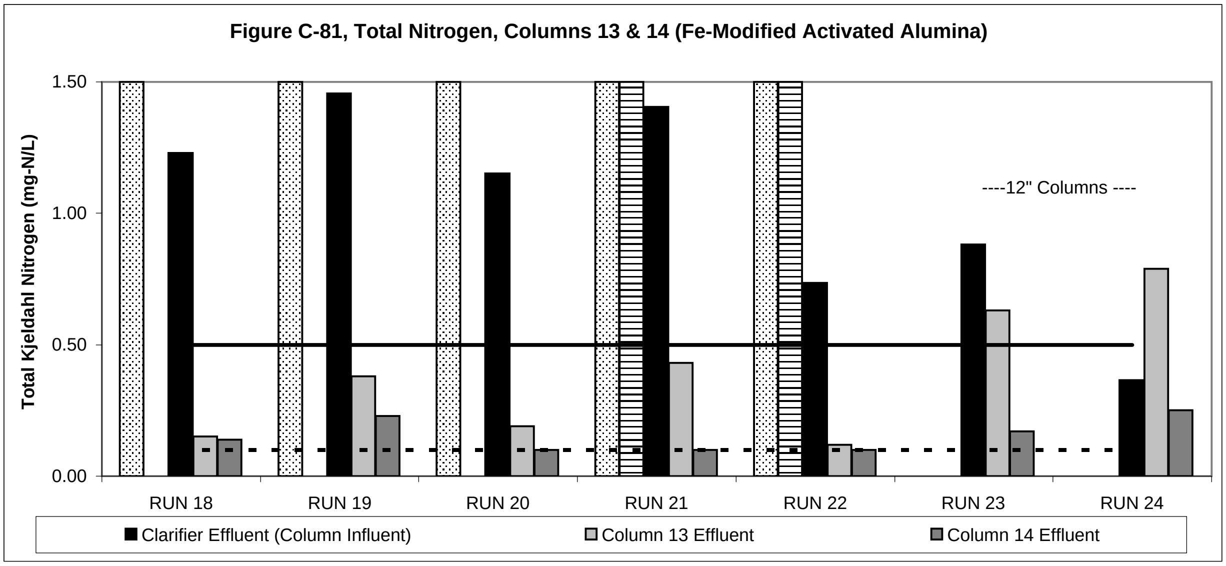


Figure C-81, Total Nitrogen, Columns 13 & 14 (Fe-Modified Activated Alumina)
Total Kjeldahl Nitrogen (mg-N/L)
1.50
1.00
0.50
0.00
----12" Columns ----
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 13 Effluent
Column 14 Effluent

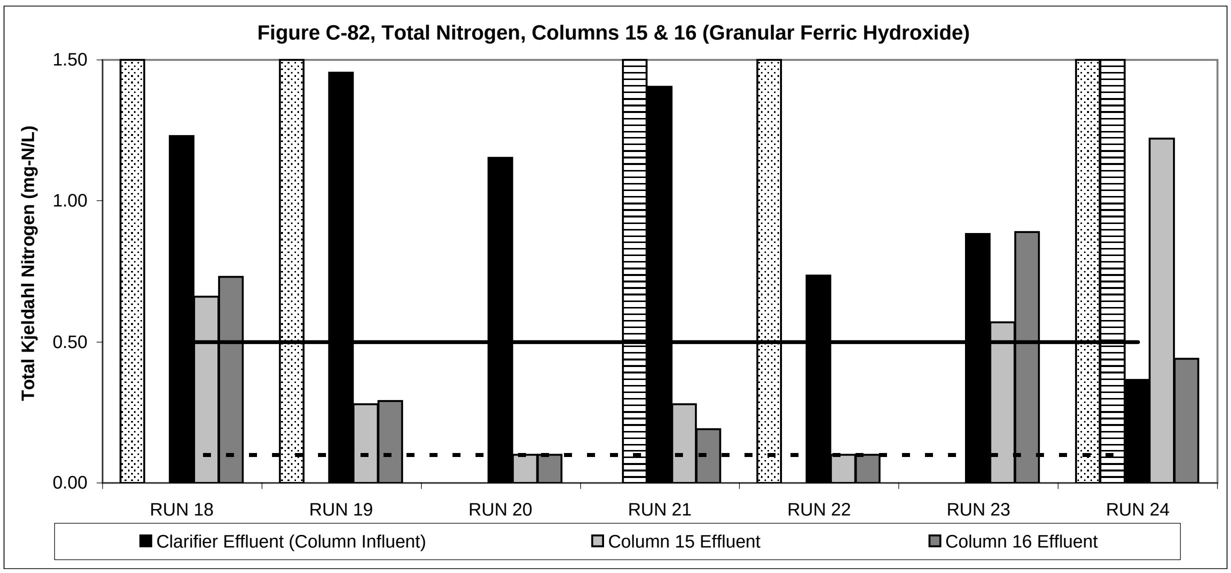


Figure C-82, Total Nitrogen, Columns 15 & 16 (Granular Ferric Hydroxide)
Total Kjeldahl Nitrogen (mg-N/L)
1.50
1.00
0.50
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 15 Effluent
Column 16 Effluent

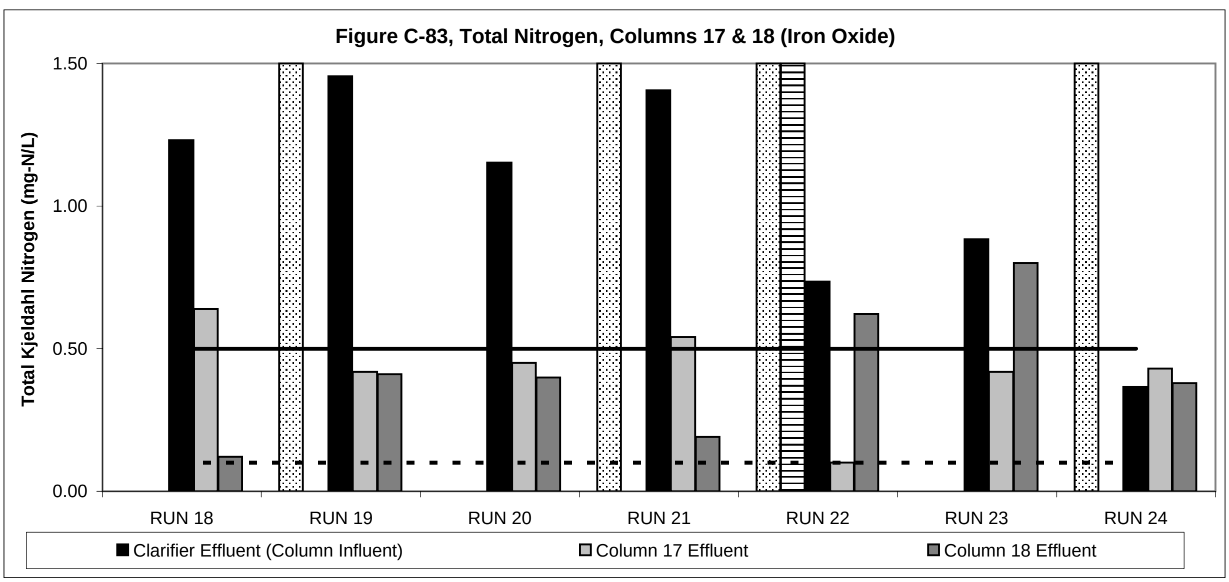


Figure C-83, Total Nitrogen, Columns 17 & 18 (Iron Oxide)
Total Kjeldahl Nitrogen (mg-N/L)
1.50
1.00
0.50
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 17 Effluent
Column 18 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

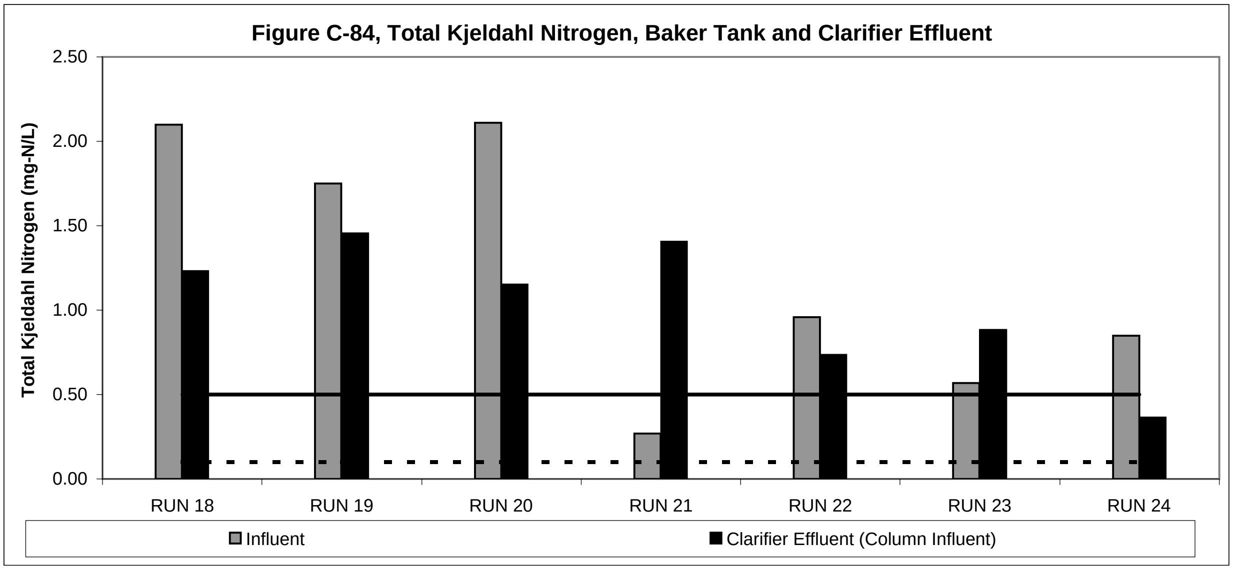


Figure C-84, Total Kjeldahl Nitrogen, Baker Tank and Clarifier Effluent
Total Kjeldahl Nitrogen (mg-N/L)
2.50
2.00
1.50
1.00
0.50
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Influent
Clarifier Effluent (Column Influent)

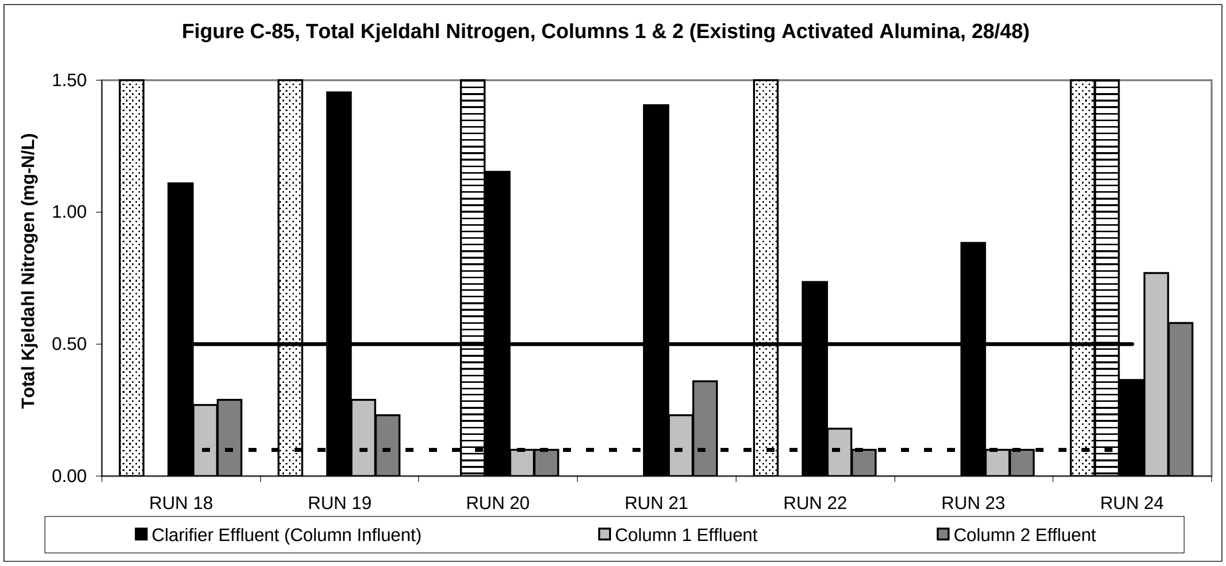


Figure C-85, Total Kjeldahl Nitrogen, Columns 1 & 2 (Existing Activated Alumina, 28/48)
Total Kjeldahl Nitrogen (mg-N/L)
1.50
1.00
0.50
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 1 Effluent
Column 2 Effluent

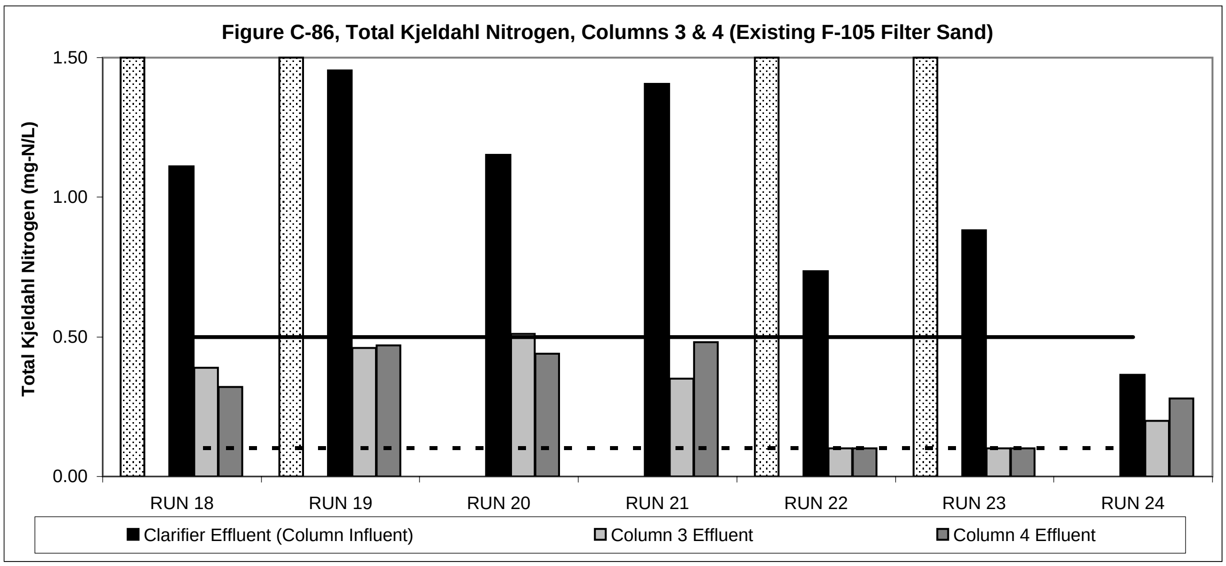


Figure C-86, Total Kjeldahl Nitrogen, Columns 3 & 4 (Existing F-105 Filter Sand)
Total Kjeldahl Nitrogen (mg-N/L)
1.50
1.00
0.50
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 3 Effluent
Column 4 Effluent

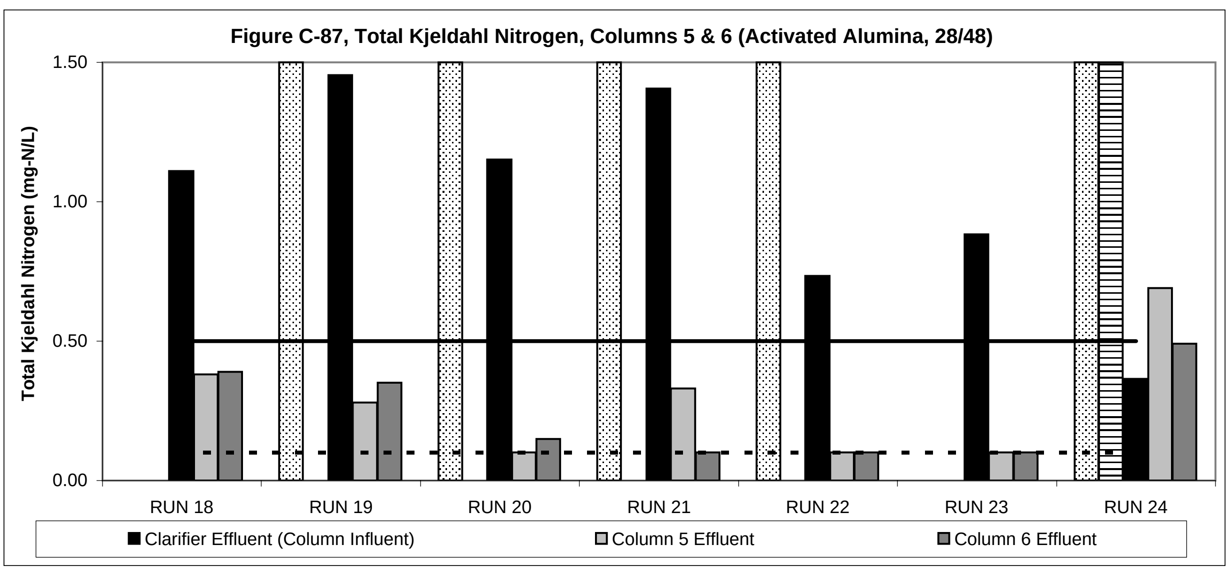


Figure C-87, Total Kjeldahl Nitrogen, Columns 5 & 6 (Activated Alumina, 28/48)
Total Kjeldahl Nitrogen (mg-N/L)
1.50
1.00
0.50
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 5 Effluent
Column 6 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

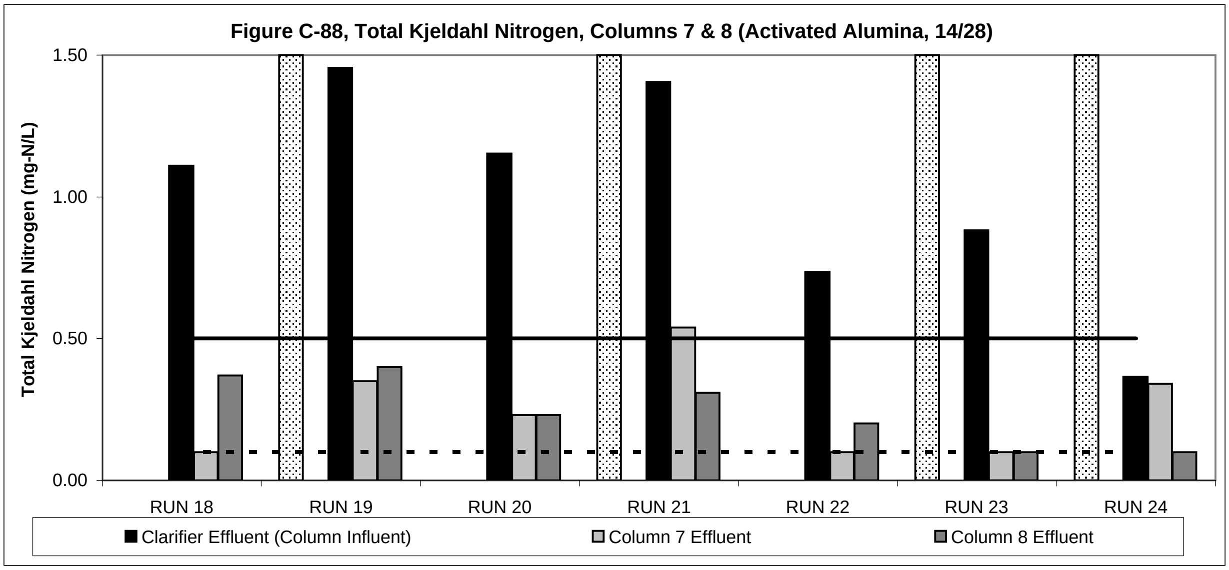


Figure C-88, Total Kjeldahl Nitrogen, Columns 7 & 8 (Activated Alumina, 14/28)
Total Kjeldahl Nitrogen (mg-N/L)
1.50
1.00
0.50
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 7 Effluent
Column 8 Effluent

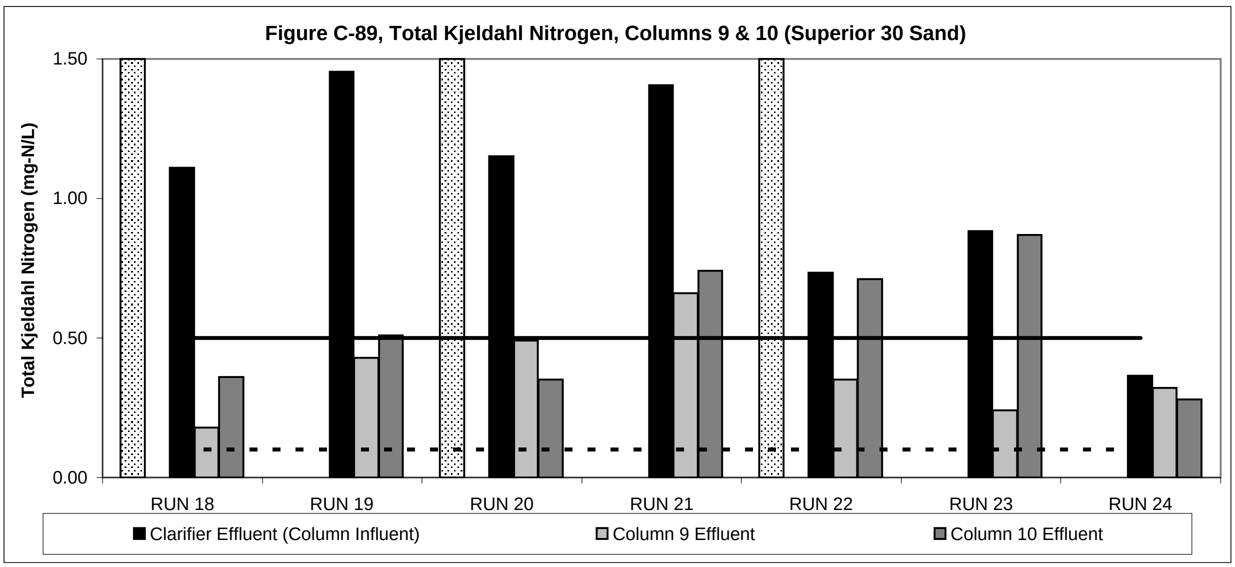


Figure C-89, Total Kjeldahl Nitrogen, Columns 9 & 10 (Superior 30 Sand)
Total Kjeldahl Nitrogen (mg-N/L)
1.50
1.00
0.50
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 9 Effluent
Column 10 Effluent

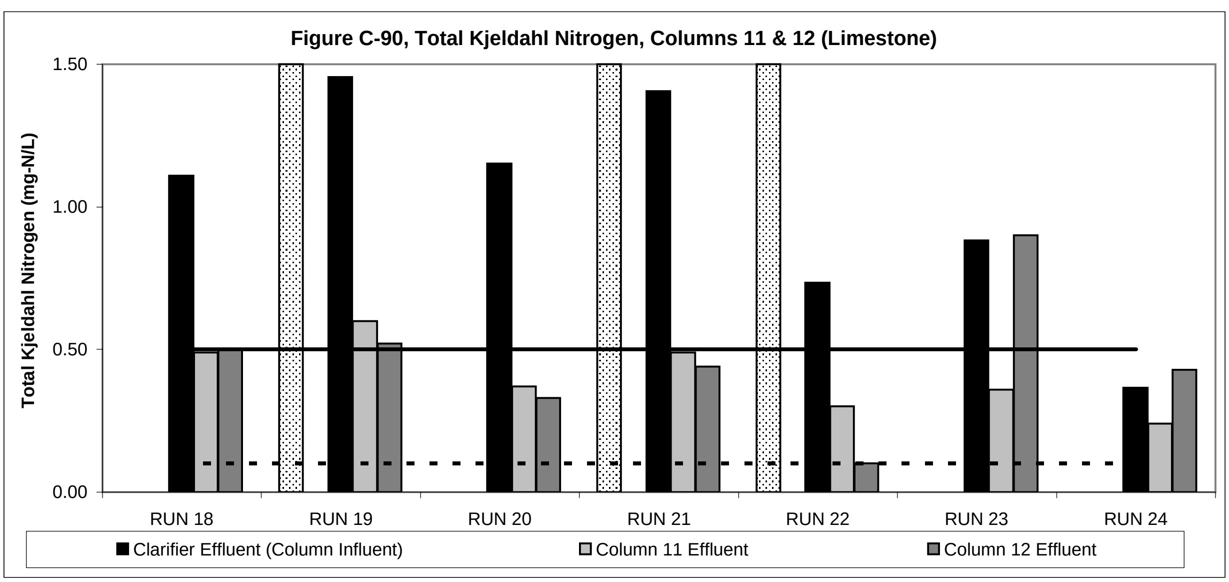


Figure C-90, Total Kjeldahl Nitrogen, Columns 11 & 12 (Limestone)
Total Kjeldahl Nitrogen (mg-N/L)
1.50
1.00
0.50
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 11 Effluent
Column 12 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

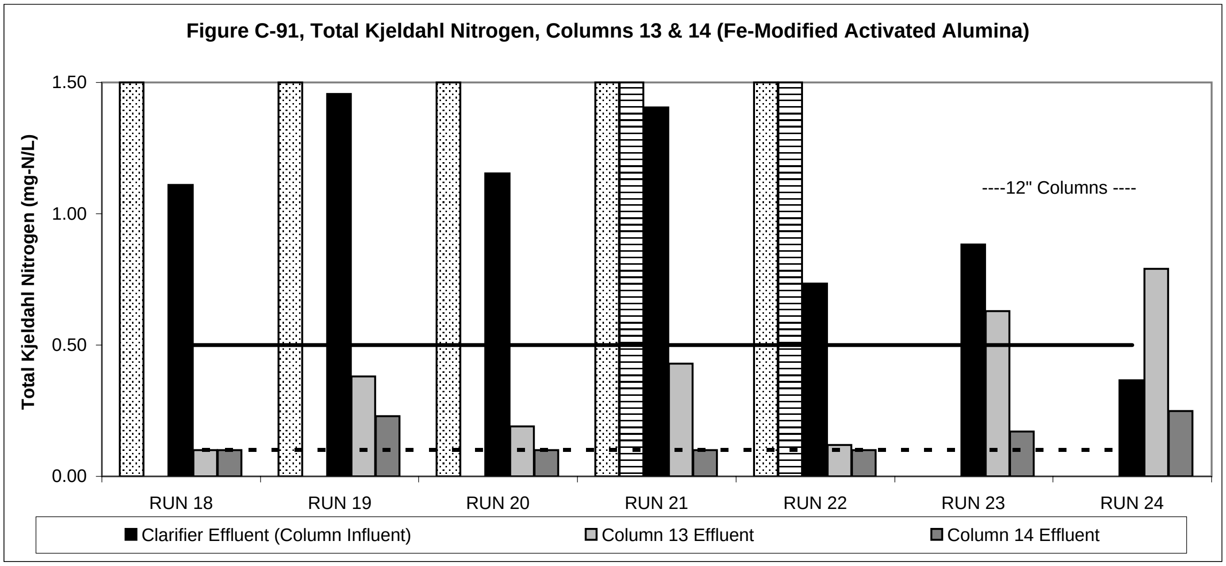


Figure C-91, Total Kjeldahl Nitrogen, Columns 13 & 14 (Fe-Modified Activated Alumina)
Total Kjeldahl Nitrogen (mg-N/L)
1.50
1.00
0.50
0.00
----12" Columns ----
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 13 Effluent
Column 14 Effluent

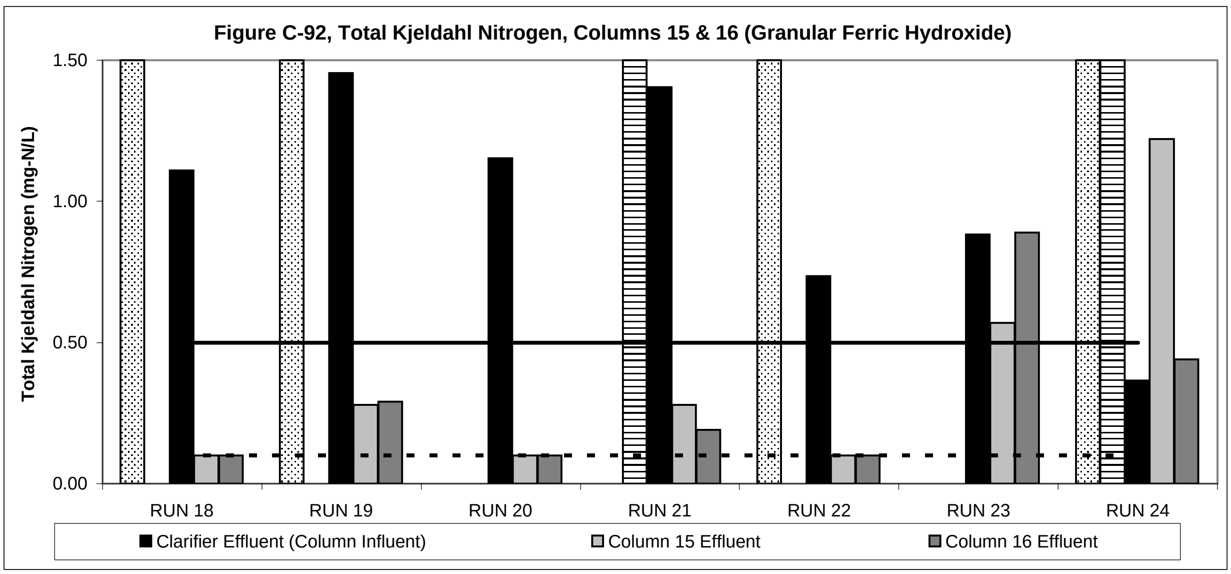


Figure C-92, Total Kjeldahl Nitrogen, Columns 15 & 16 (Granular Ferric Hydroxide)
Total Kjeldahl Nitrogen (mg-N/L)
1.50
1.00
0.50
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 15 Effluent
Column 16 Effluent

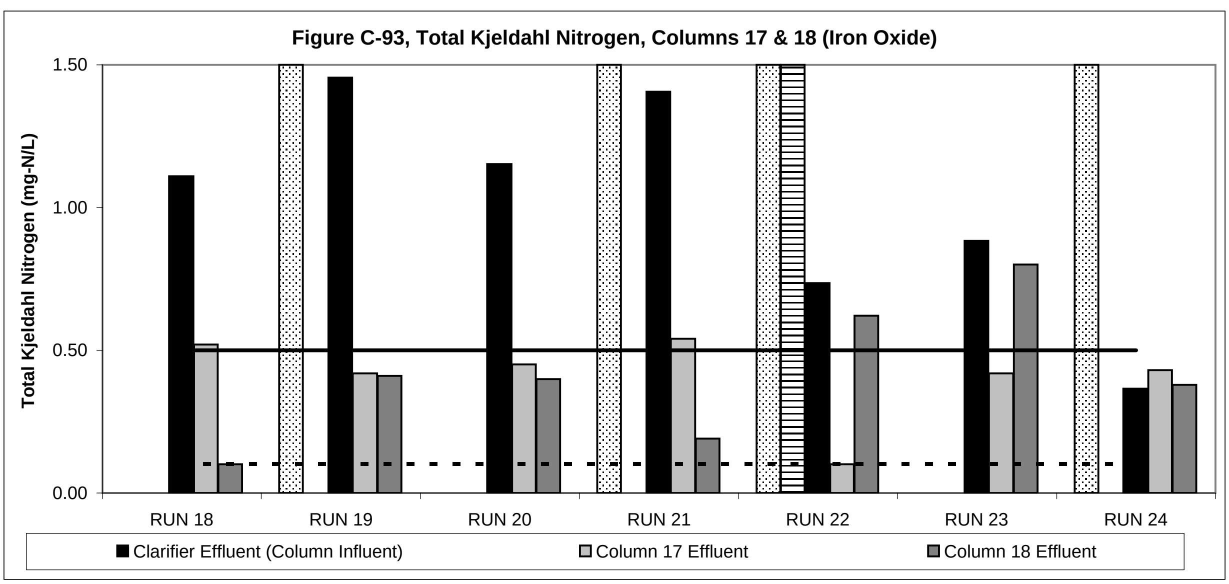


Figure C-93, Total Kjeldahl Nitrogen, Columns 17 & 18 (Iron Oxide)
Total Kjeldahl Nitrogen (mg-N/L)
1.50
1.00
0.50
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 17 Effluent
Column 18 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

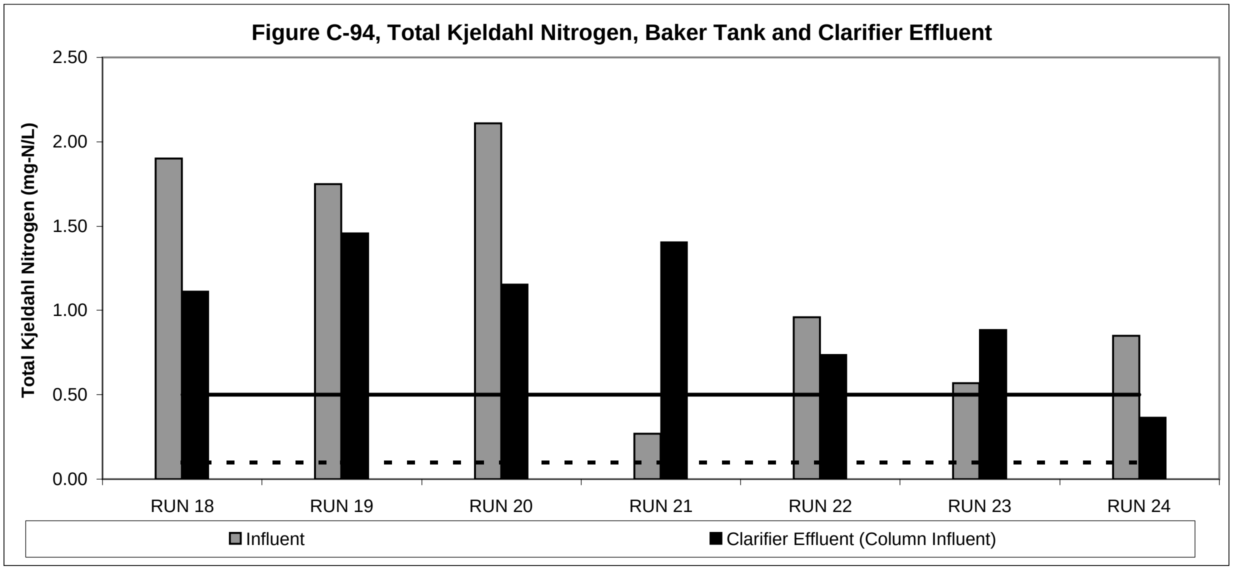


Figure C-94, Total Kjeldahl Nitrogen, Baker Tank and Clarifier Effluent
Total Kjeldahl Nitrogen (mg-N/L)
2.50
2.00
1.50
1.00
0.50
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Influent
Clarifier Effluent (Column Influent)

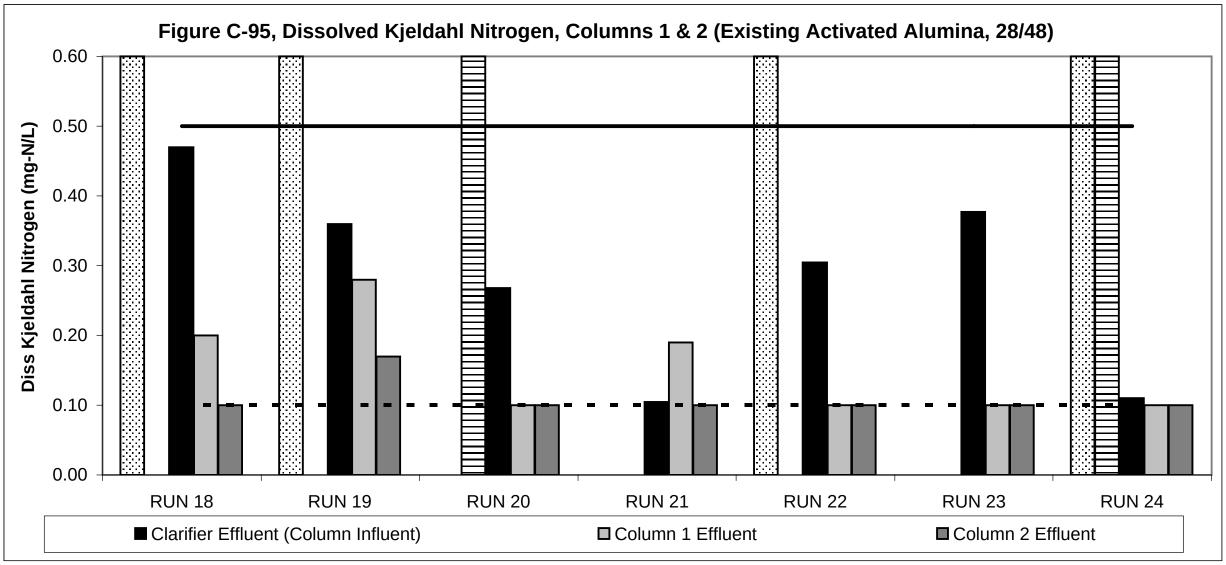


Figure C-95, Dissolved Kjeldahl Nitrogen, Columns 1 & 2 (Existing Activated Alumina, 28/48)
Diss Kjeldahl Nitrogen (mg-N/L)
0.60
0.50
0.40
0.30
0.20
0.10
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 1 Effluent
Column 2 Effluent

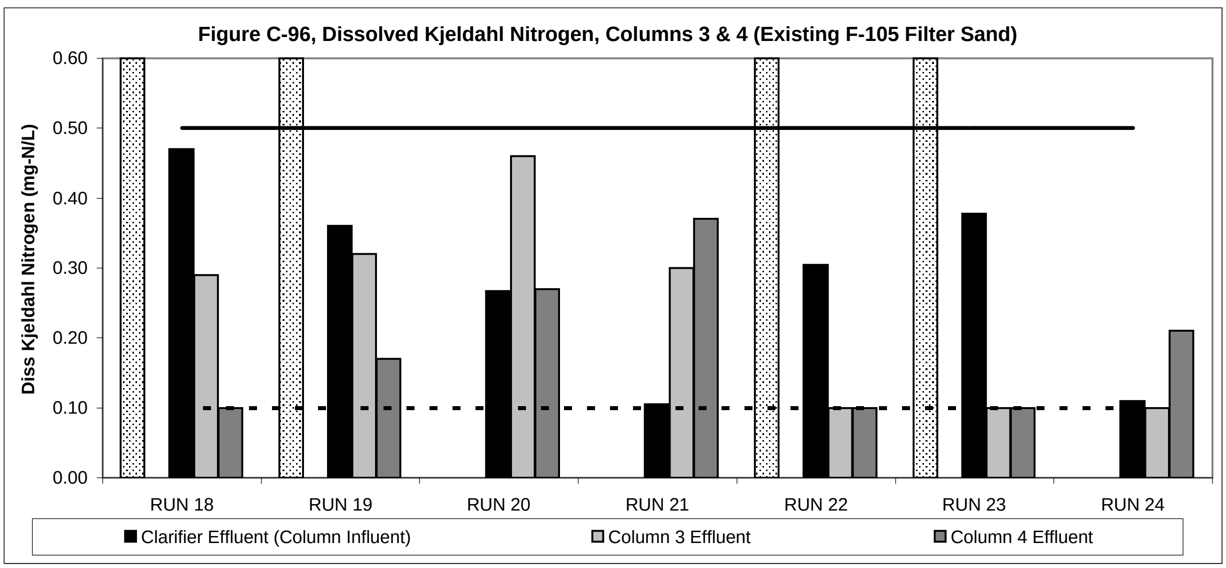


Figure C-96, Dissolved Kjeldahl Nitrogen, Columns 3 & 4 (Existing F-105 Filter Sand)
Diss Kjeldahl Nitrogen (mg-N/L)
0.60
0.50
0.40
0.30
0.20
0.10
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 3 Effluent
Column 4 Effluent

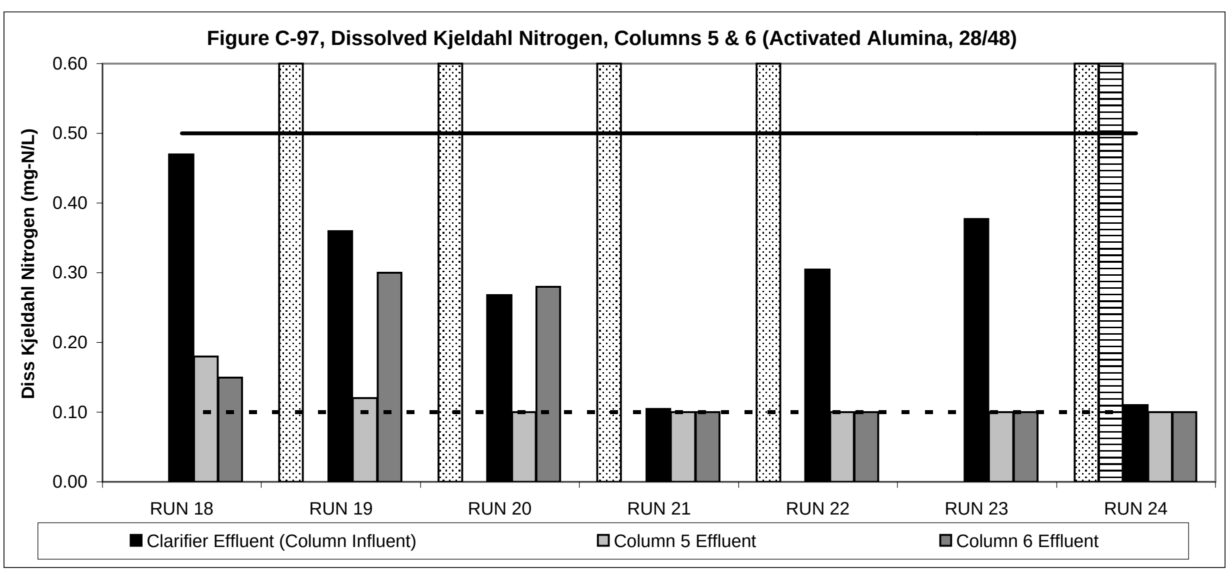


Figure C-97, Dissolved Kjeldahl Nitrogen, Columns 5 & 6 (Activated Alumina, 28/48)
Diss Kjeldahl Nitrogen (mg-N/L)
0.60
0.50
0.40
0.30
0.20
0.10
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 5 Effluent
Column 6 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

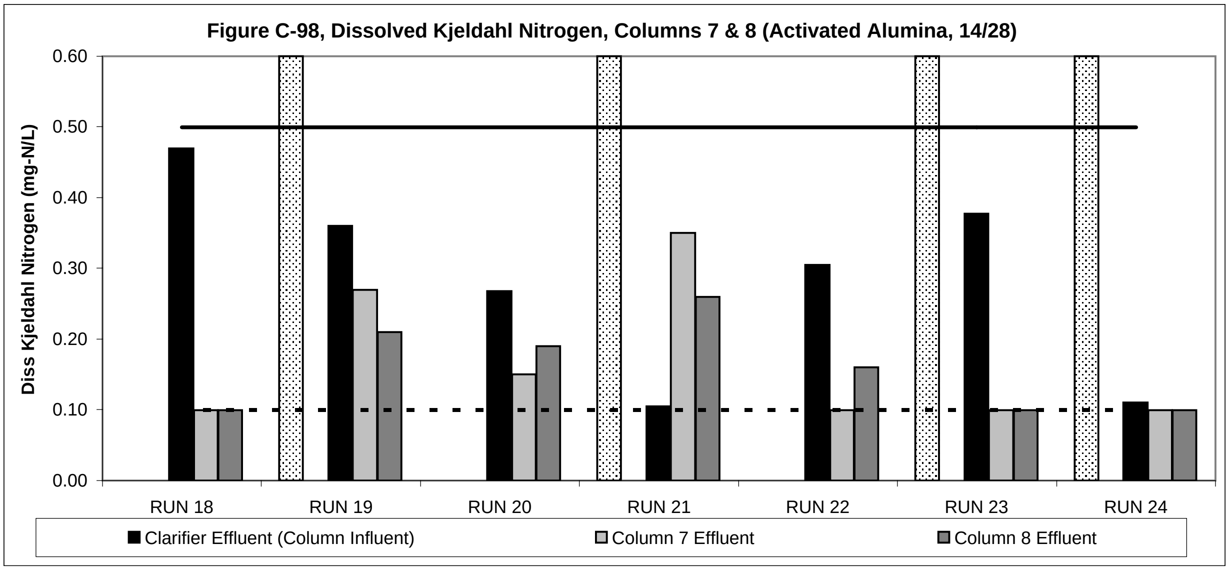


Figure C-98, Dissolved Kjeldahl Nitrogen, Columns 7 & 8 (Activated Alumina, 14/28)
Diss Kjeldahl Nitrogen (mg-N/L)
0.00
0.10
0.20
0.30
0.40
0.50
0.60
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 7 Effluent
Column 8 Effluent

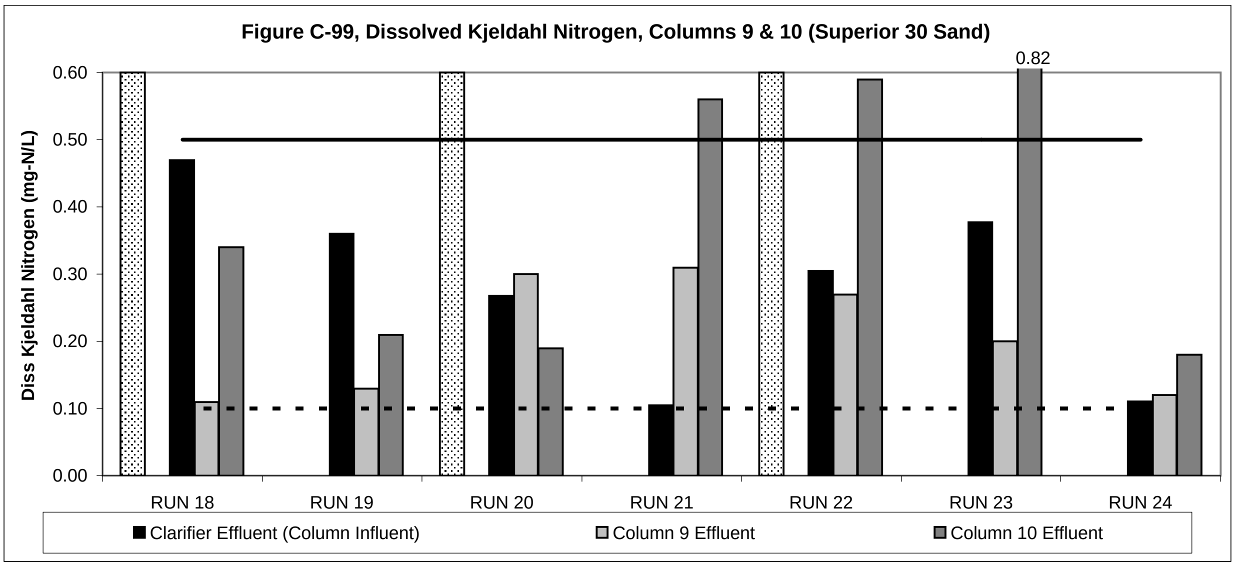


Figure C-99, Dissolved Kjeldahl Nitrogen, Columns 9 & 10 (Superior 30 Sand)
0.82
Diss Kjeldahl Nitrogen (mg-N/L)
0.00
0.10
0.20
0.30
0.40
0.50
0.60
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 9 Effluent
Column 10 Effluent

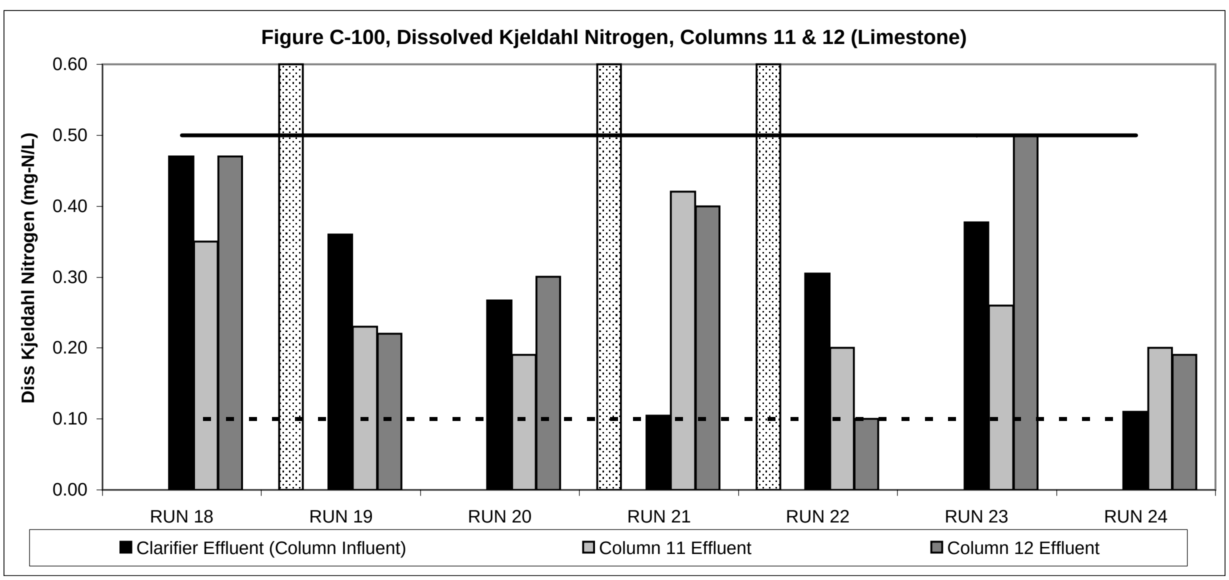


Figure C-100, Dissolved Kjeldahl Nitrogen, Columns 11 & 12 (Limestone)
Diss Kjeldahl Nitrogen (mg-N/L)
0.00
0.10
0.20
0.30
0.40
0.50
0.60
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 11 Effluent
Column 12 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

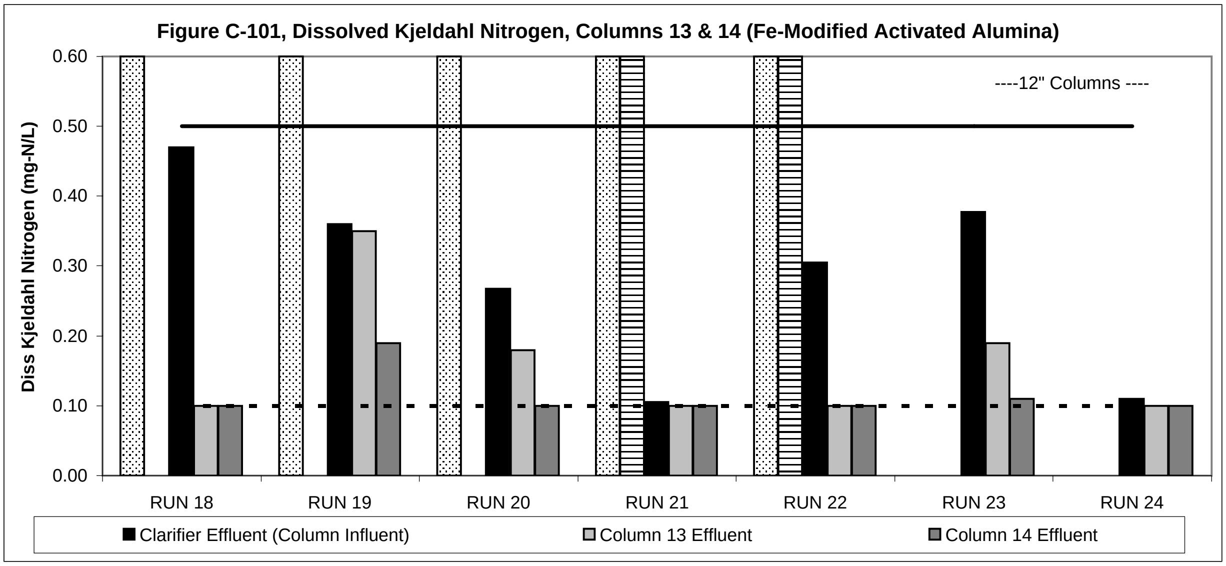


Figure C-101, Dissolved Kjeldahl Nitrogen, Columns 13 & 14 (Fe-Modified Activated Alumina)
Diss Kjeldahl Nitrogen (mg-N/L)
0.00
0.10
0.20
0.30
0.40
0.50
0.60
----12" Columns ----
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 13 Effluent
Column 14 Effluent

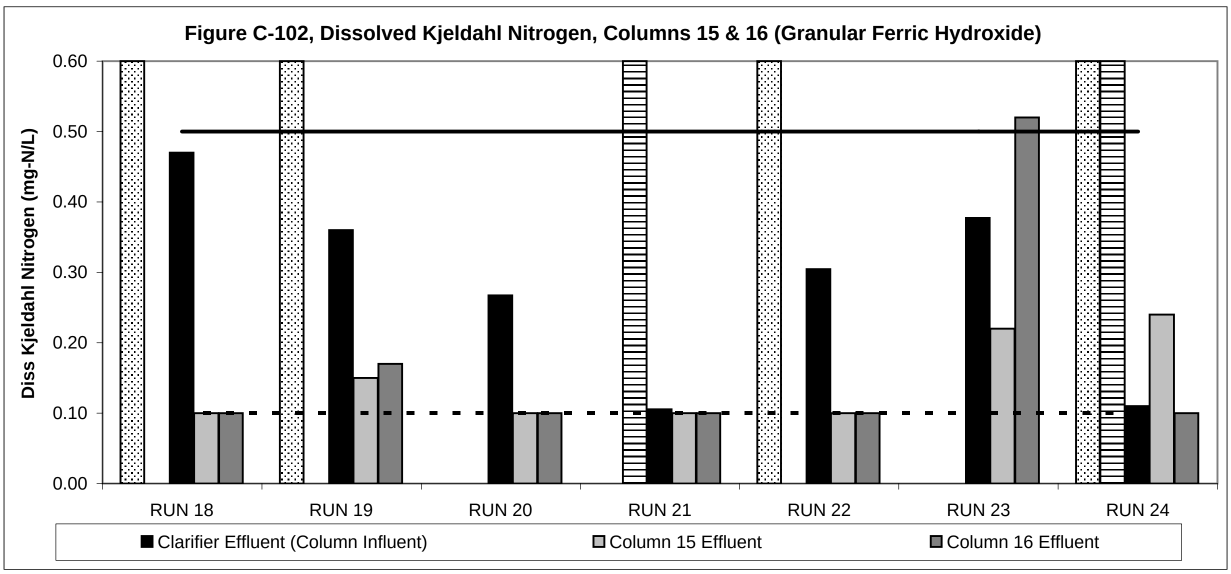


Figure C-102, Dissolved Kjeldahl Nitrogen, Columns 15 & 16 (Granular Ferric Hydroxide)
Diss Kjeldahl Nitrogen (mg-N/L)
0.00
0.10
0.20
0.30
0.40
0.50
0.60
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 15 Effluent
Column 16 Effluent

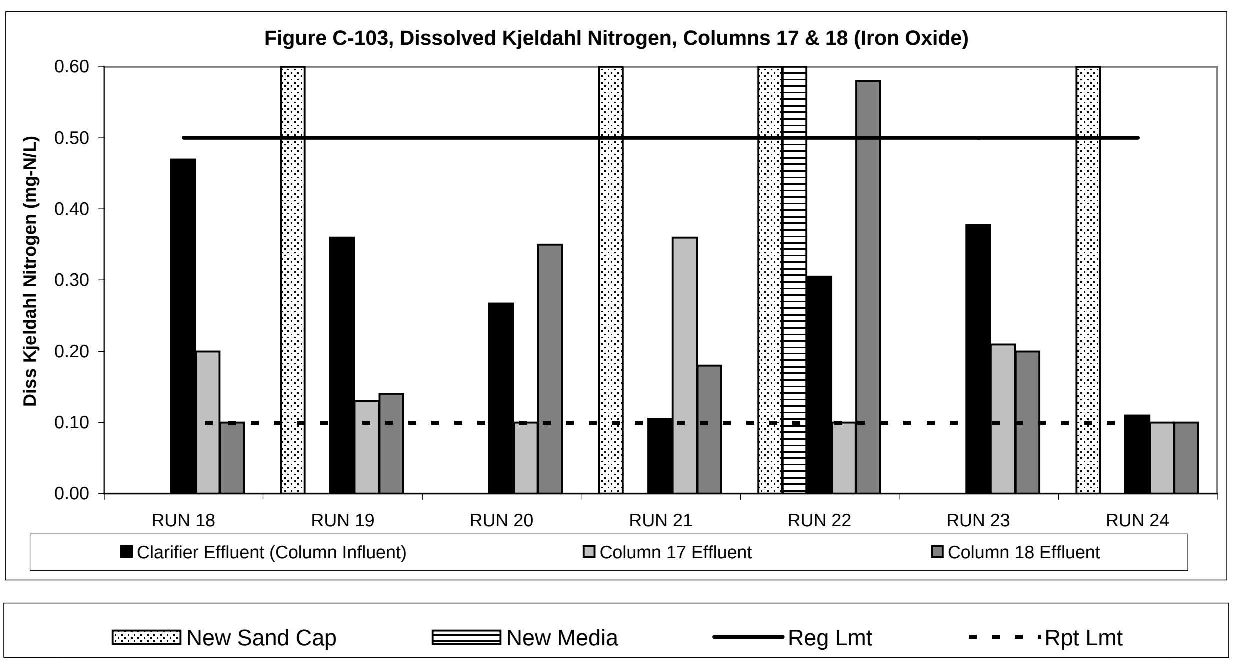


Figure C-103, Dissolved Kjeldahl Nitrogen, Columns 17 & 18 (Iron Oxide)
Diss Kjeldahl Nitrogen (mg-N/L)
0.00
0.10
0.20
0.30
0.40
0.50
0.60
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 17 Effluent
Column 18 Effluent
New Sand Cap
New Media
Reg Lmt
Rpt Lmt

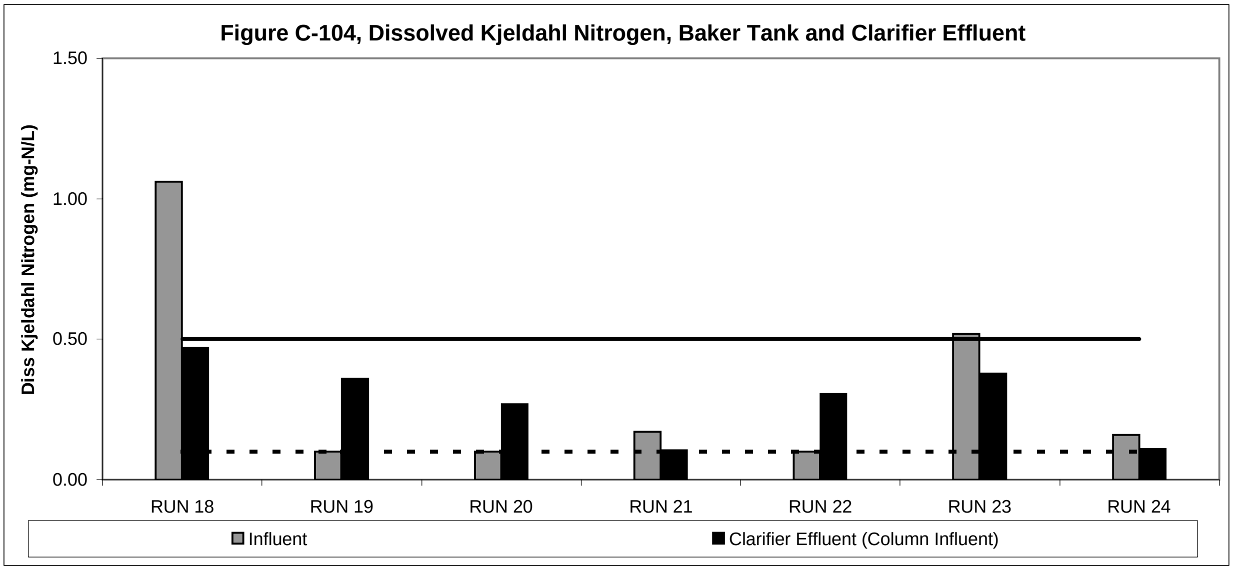


Figure C-104, Dissolved Kjeldahl Nitrogen, Baker Tank and Clarifier Effluent
Diss Kjeldahl Nitrogen (mg-N/L)
1.50
1.00
0.50
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Influent
Clarifier Effluent (Column Influent)

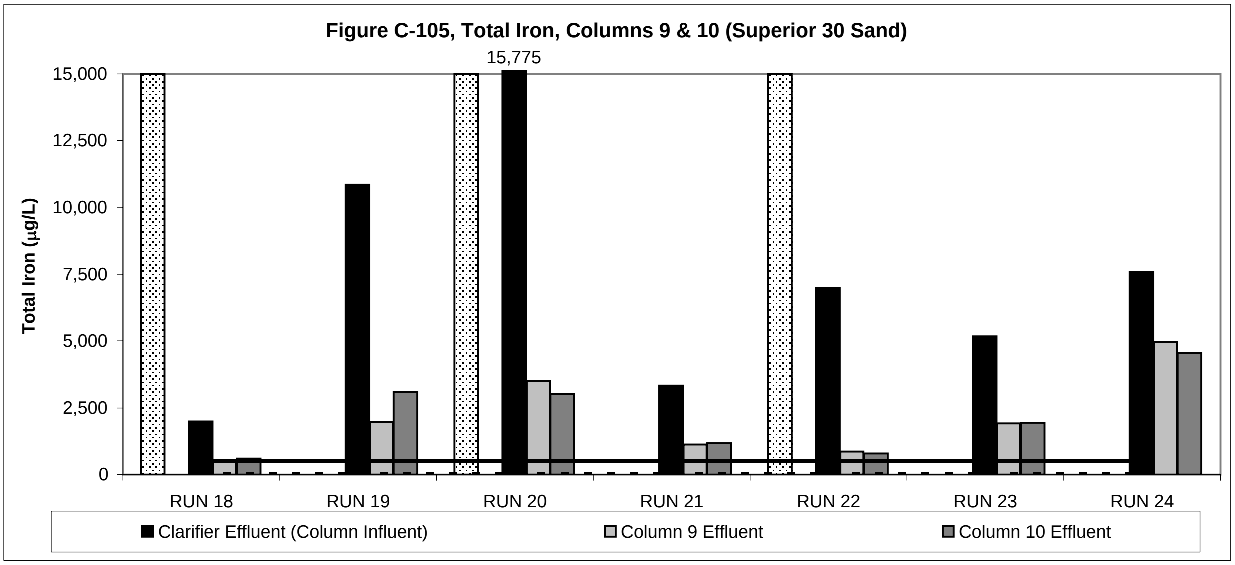


Figure C-105, Total Iron, Columns 9 & 10 (Superior 30 Sand)
15,775
Total Iron (μg/L)
15,000
12,500
10,000
7,500
5,000
2,500
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 9 Effluent
Column 10 Effluent

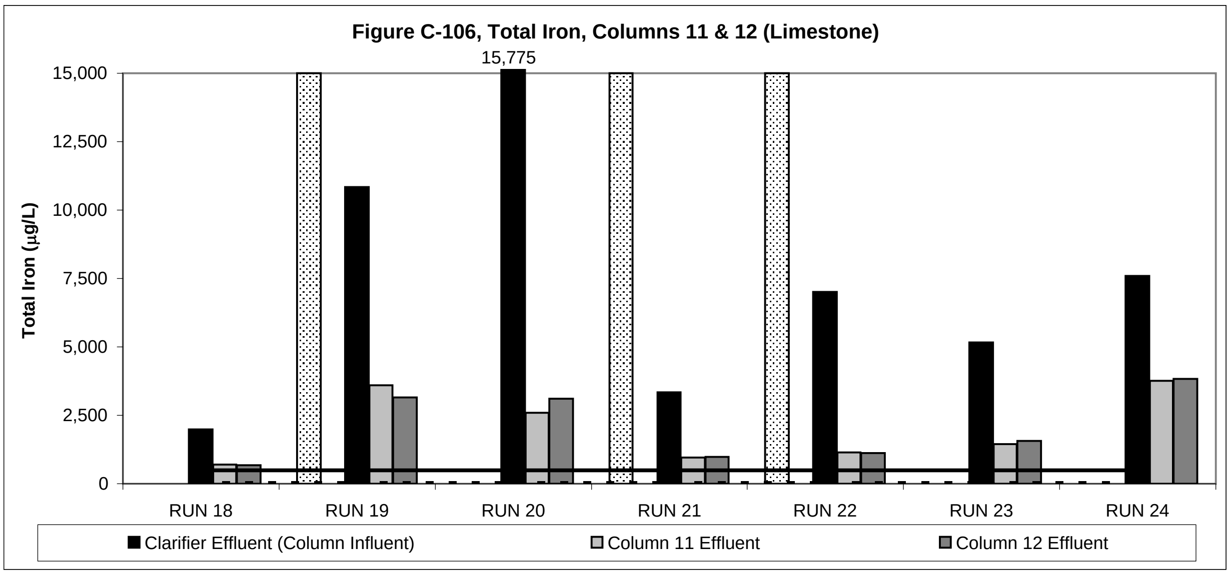


Figure C-106, Total Iron, Columns 11 & 12 (Limestone)
15,775
Total Iron (μg/L)
15,000
12,500
10,000
7,500
5,000
2,500
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 11 Effluent
Column 12 Effluent

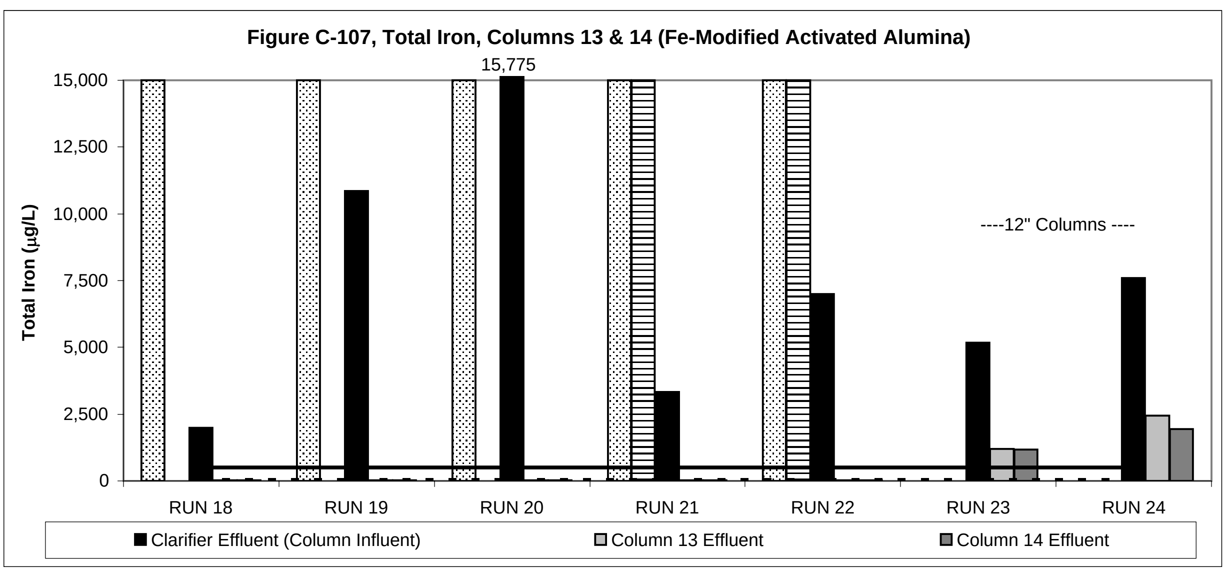
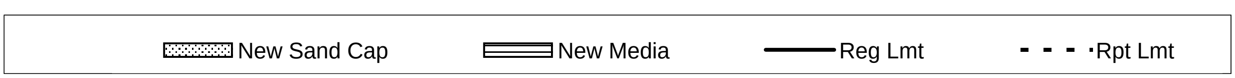


Figure C-107, Total Iron, Columns 13 & 14 (Fe-Modified Activated Alumina)
15,775
----12" Columns ----
Total Iron (μg/L)
15,000
12,500
10,000
7,500
5,000
2,500
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 13 Effluent
Column 14 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

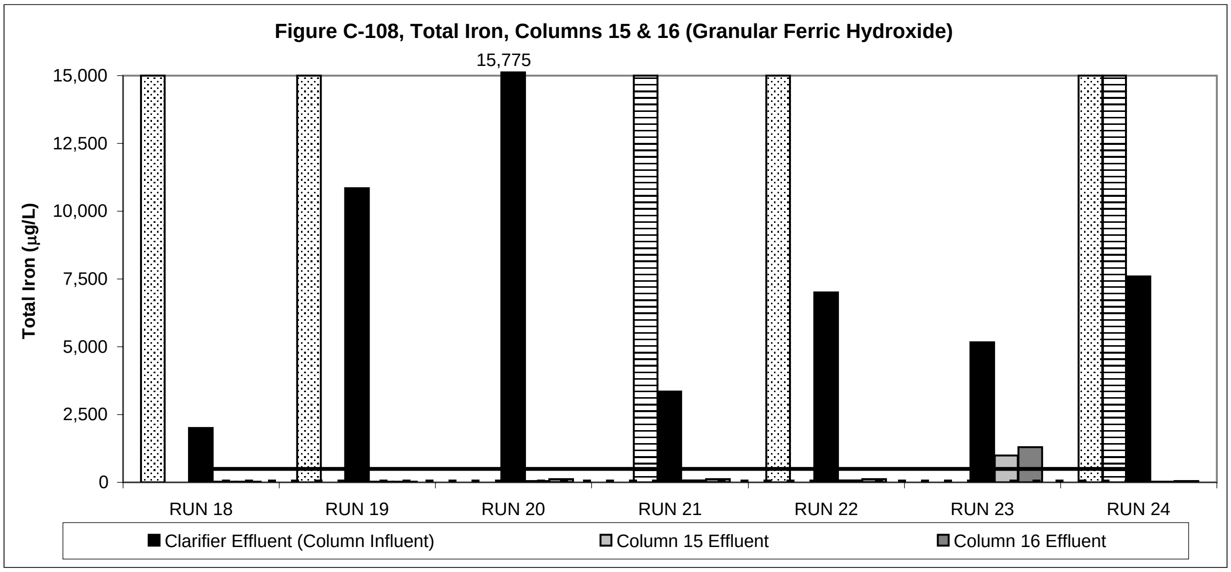


Figure C-108, Total Iron, Columns 15 & 16 (Granular Ferric Hydroxide)
15,775
Total Iron (µg/L)
15,000
12,500
10,000
7,500
5,000
2,500
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 15 Effluent
Column 16 Effluent

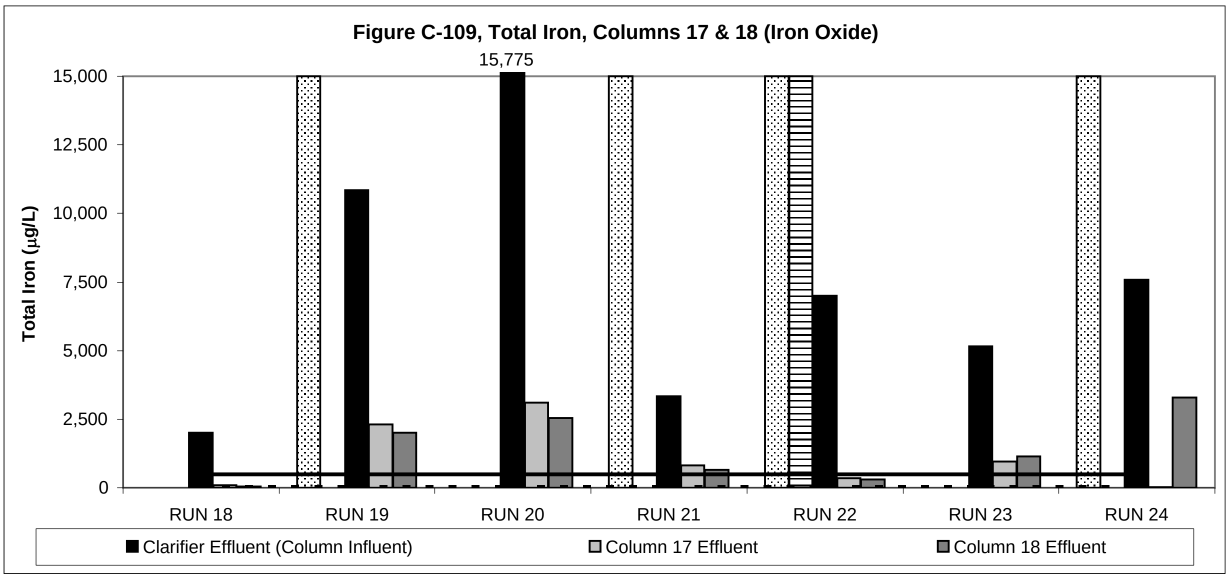


Figure C-109, Total Iron, Columns 17 & 18 (Iron Oxide)
15,775
Total Iron (µg/L)
15,000
12,500
10,000
7,500
5,000
2,500
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 17 Effluent
Column 18 Effluent

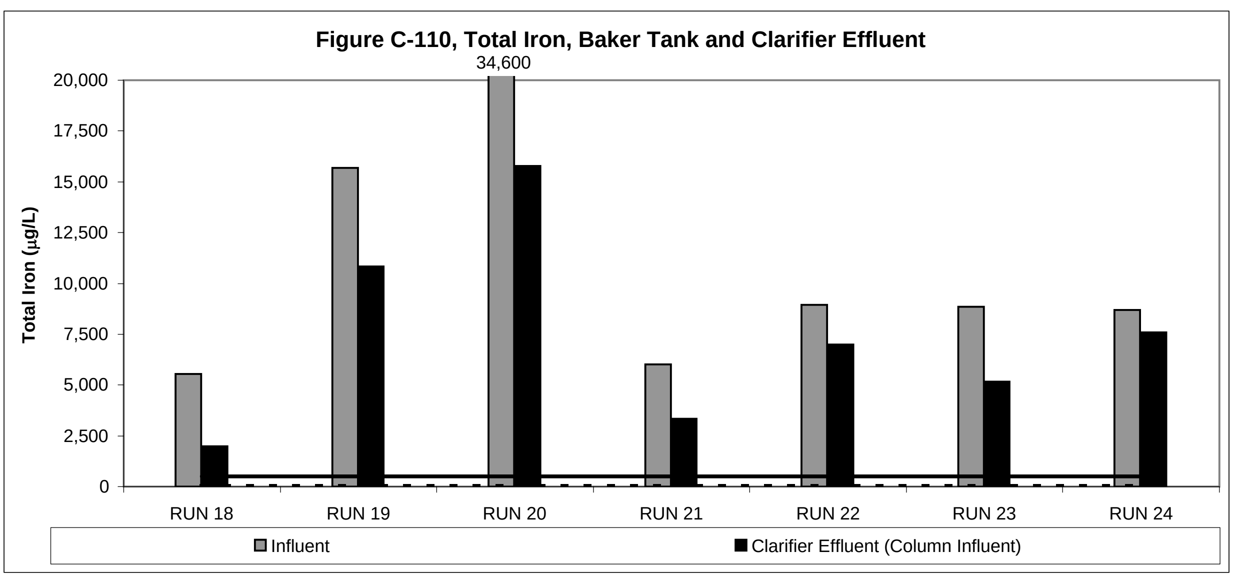


Figure C-110, Total Iron, Baker Tank and Clarifier Effluent
34,600
Total Iron (µg/L)
20,000
17,500
15,000
12,500
10,000
7,500
5,000
2,500
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Influent
Clarifier Effluent (Column Influent)


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

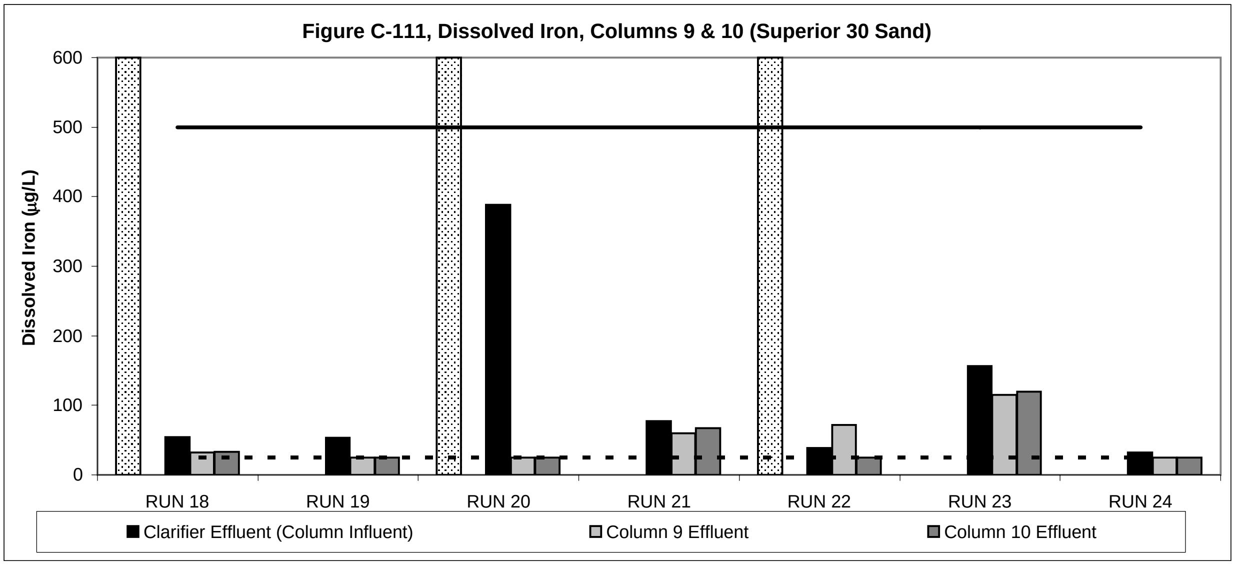


Figure C-111, Dissolved Iron, Columns 9 & 10 (Superior 30 Sand)
Dissolved Iron (µg/L)
0
100
200
300
400
500
600
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 9 Effluent
Column 10 Effluent

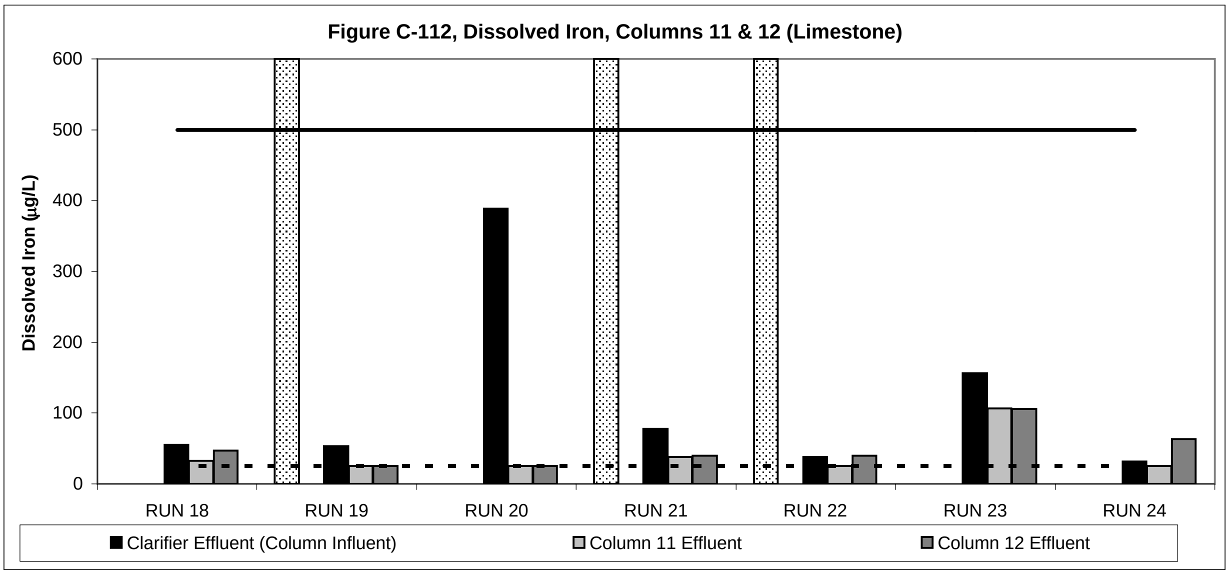


Figure C-112, Dissolved Iron, Columns 11 & 12 (Limestone)
Dissolved Iron (µg/L)
0
100
200
300
400
500
600
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 11 Effluent
Column 12 Effluent

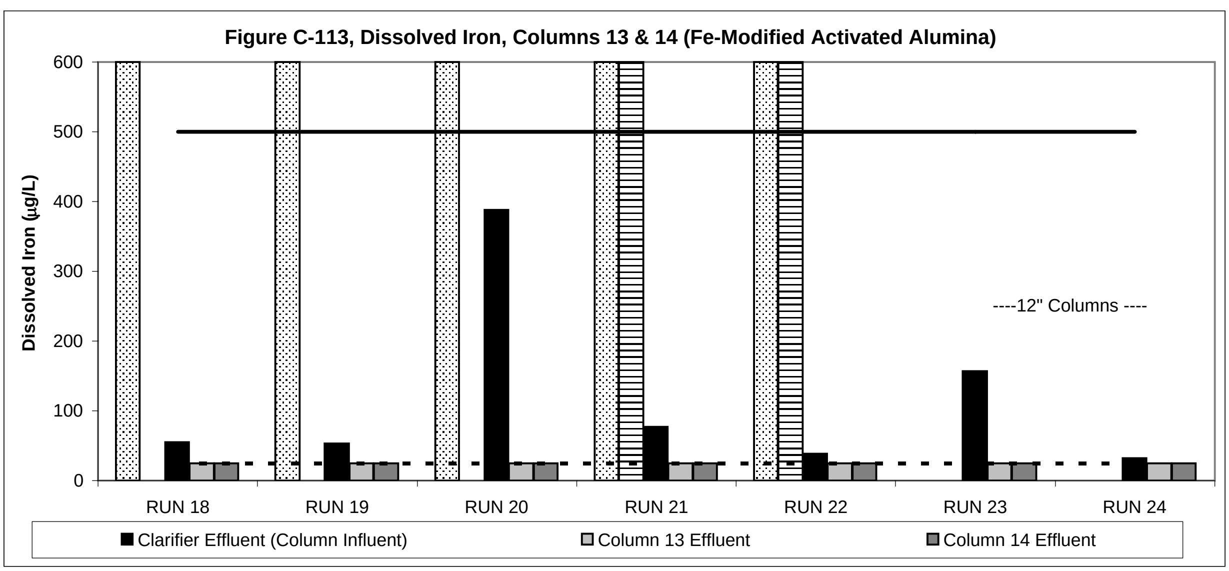
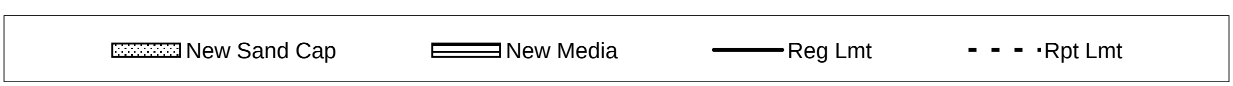


Figure C-113, Dissolved Iron, Columns 13 & 14 (Fe-Modified Activated Alumina)
Dissolved Iron (µg/L)
0
100
200
300
400
500
600
----12" Columns ----
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 13 Effluent
Column 14 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

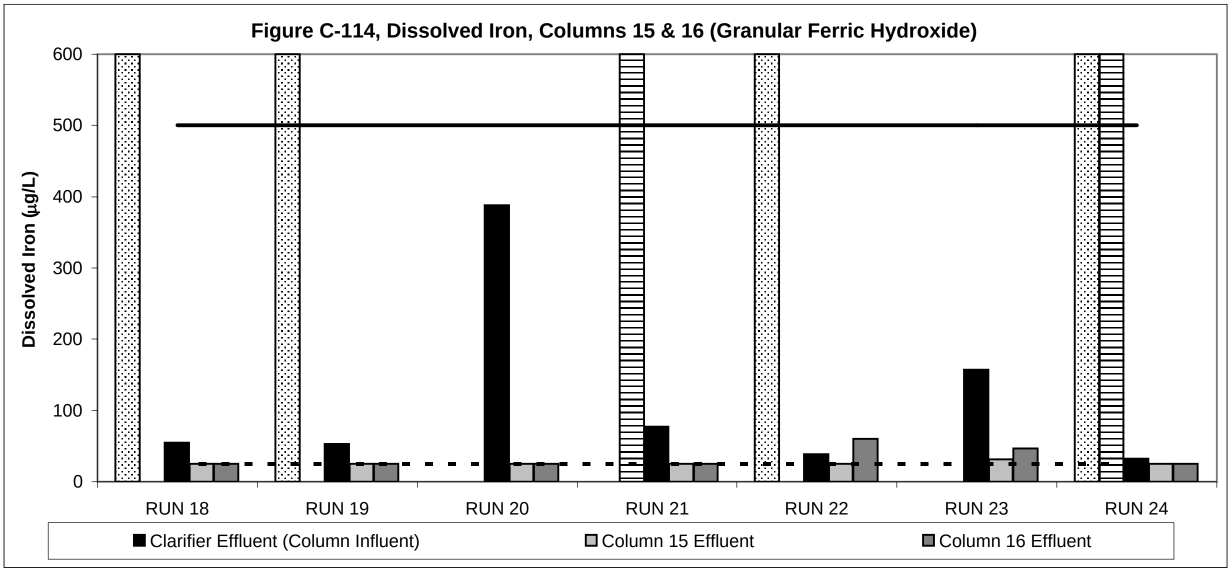


Figure C-114, Dissolved Iron, Columns 15 & 16 (Granular Ferric Hydroxide)
Dissolved Iron (µg/L)
600
500
400
300
200
100
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 15 Effluent
Column 16 Effluent

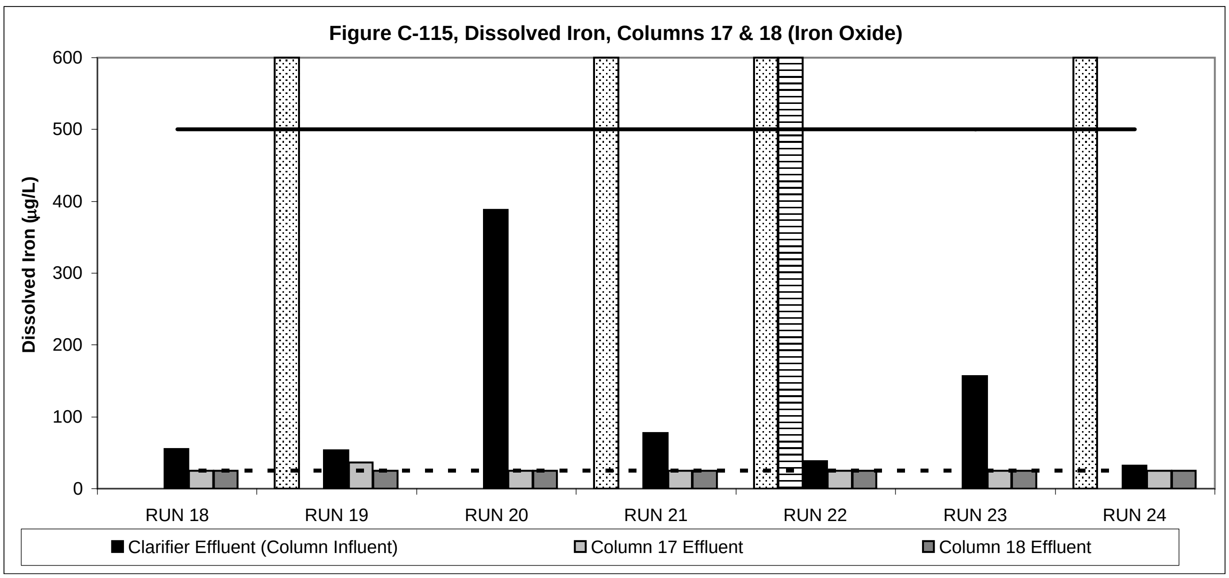


Figure C-115, Dissolved Iron, Columns 17 & 18 (Iron Oxide)
Dissolved Iron (µg/L)
600
500
400
300
200
100
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 17 Effluent
Column 18 Effluent

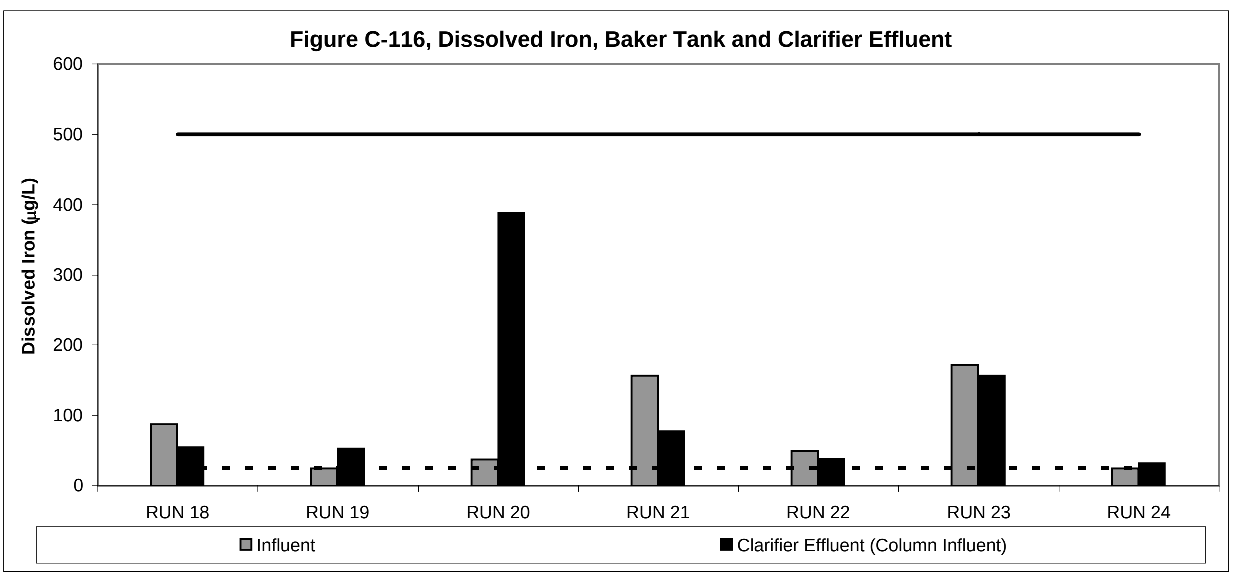
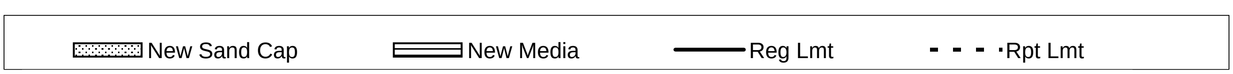


Figure C-116, Dissolved Iron, Baker Tank and Clarifier Effluent
Dissolved Iron (µg/L)
600
500
400
300
200
100
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Influent
Clarifier Effluent (Column Influent)


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

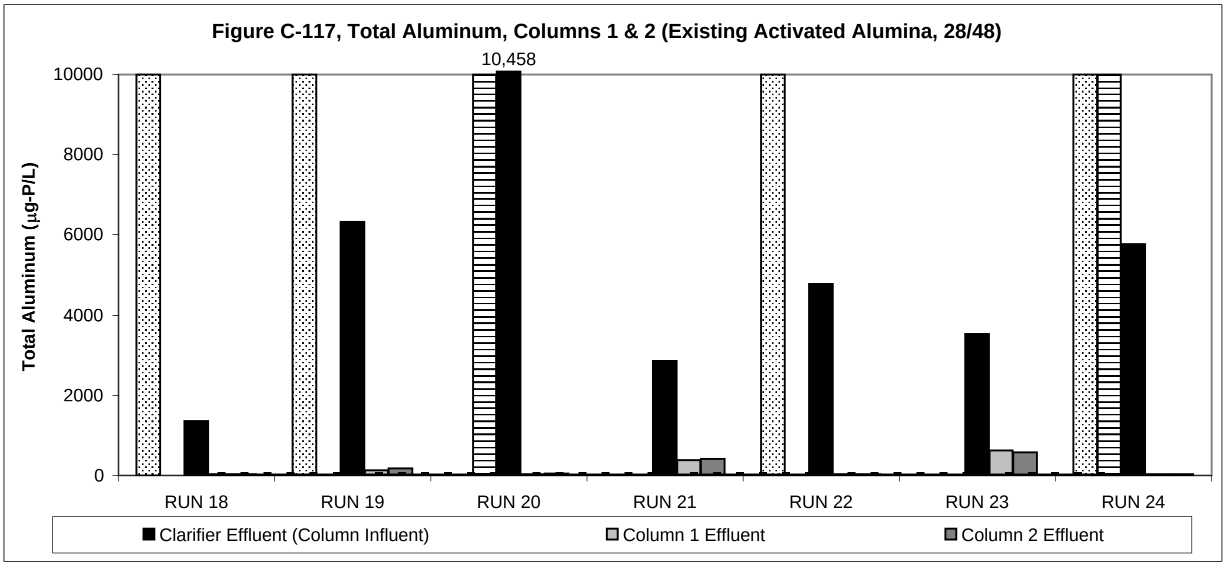


Figure C-117, Total Aluminum, Columns 1 & 2 (Existing Activated Alumina, 28/48)
10,458
Total Aluminum (µg-P/L)
10000
8000
6000
4000
2000
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 1 Effluent
Column 2 Effluent

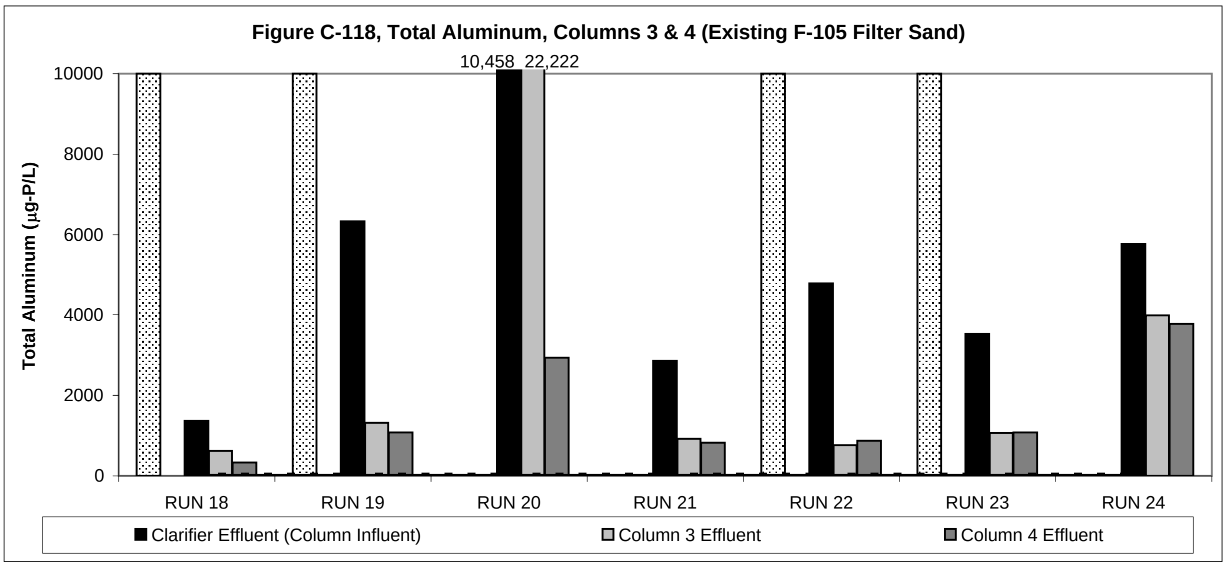


Figure C-118, Total Aluminum, Columns 3 & 4 (Existing F-105 Filter Sand)
10,458
22,222
Total Aluminum (µg-P/L)
10000
8000
6000
4000
2000
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 3 Effluent
Column 4 Effluent

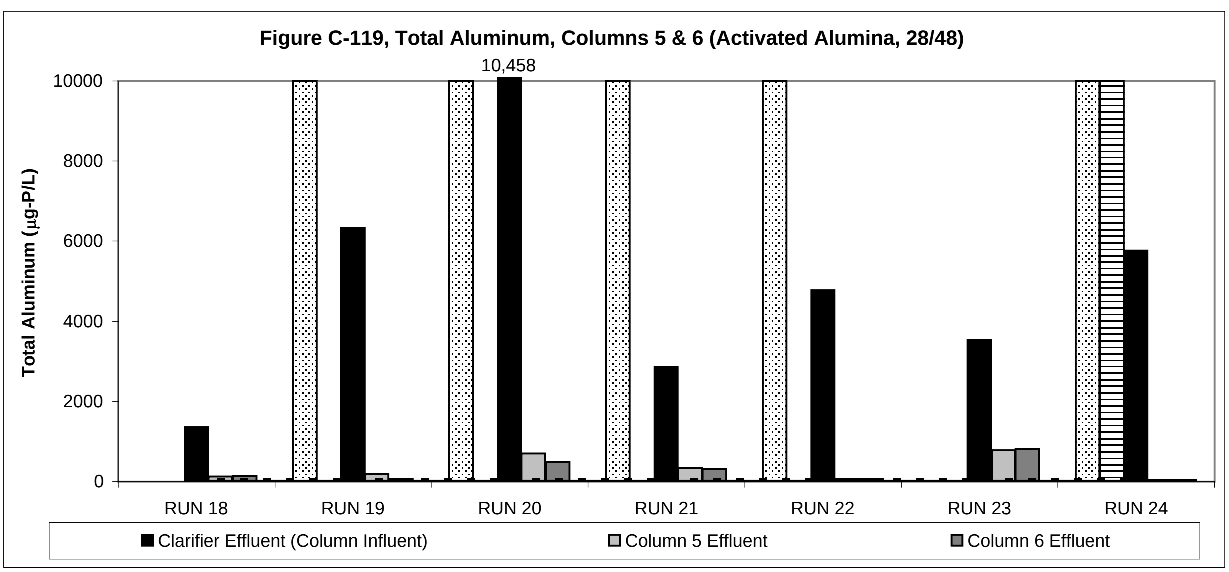


Figure C-119, Total Aluminum, Columns 5 & 6 (Activated Alumina, 28/48)
10,458
Total Aluminum (µg-P/L)
10000
8000
6000
4000
2000
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 5 Effluent
Column 6 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

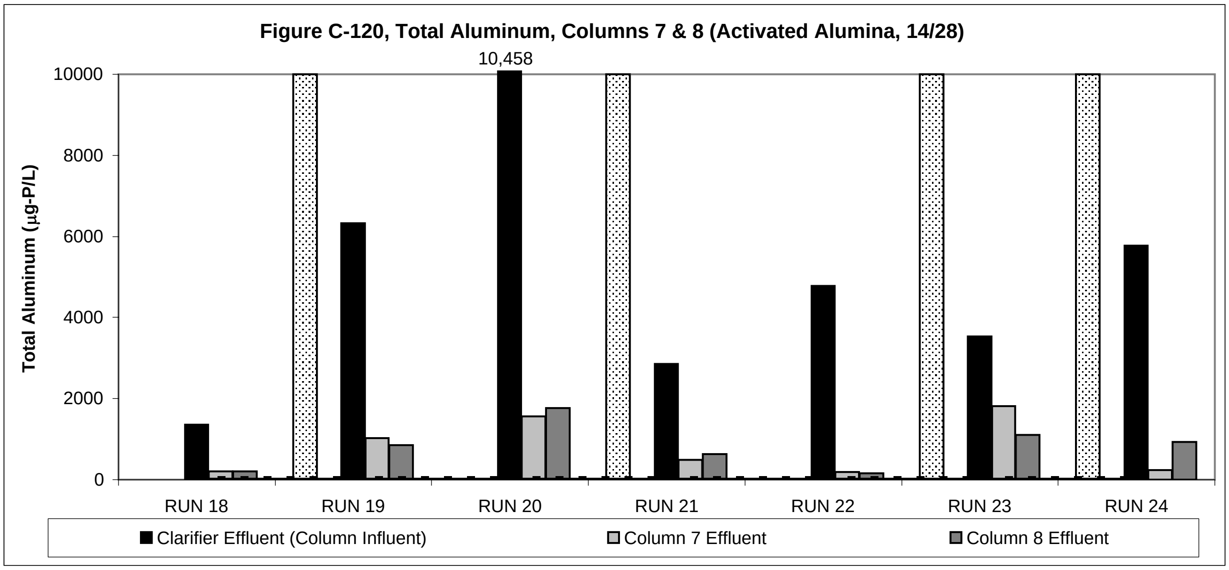


Figure C-120, Total Aluminum, Columns 7 & 8 (Activated Alumina, 14/28)
10,458
Total Aluminum (µg-P/L)
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 7 Effluent
Column 8 Effluent

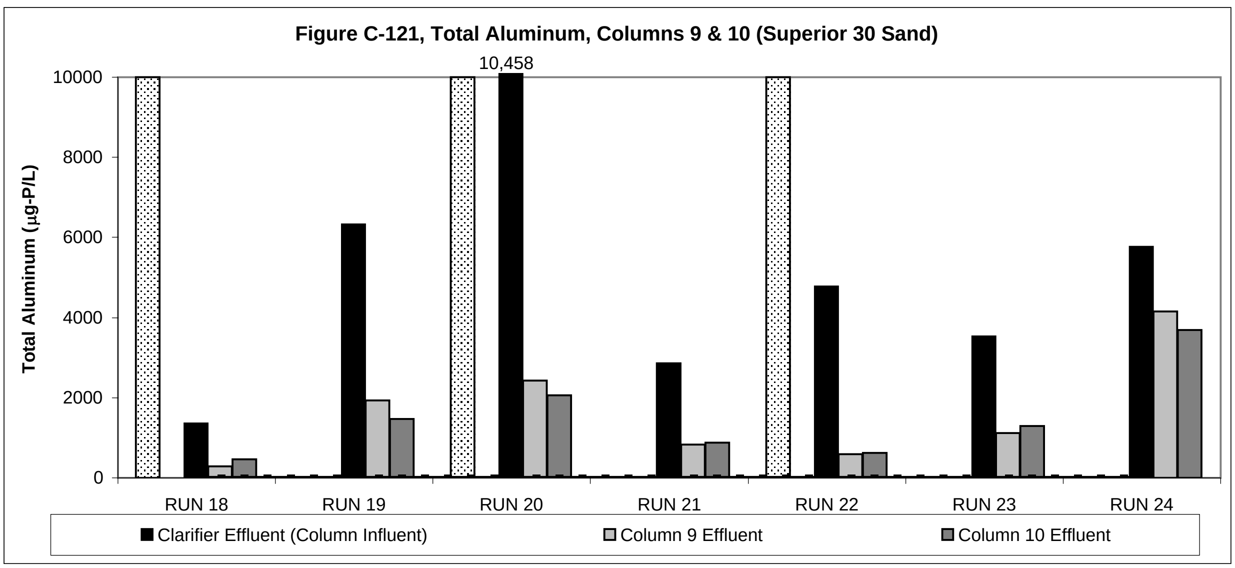


Figure C-121, Total Aluminum, Columns 9 & 10 (Superior 30 Sand)
10,458
Total Aluminum (µg-P/L)
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 9 Effluent
Column 10 Effluent

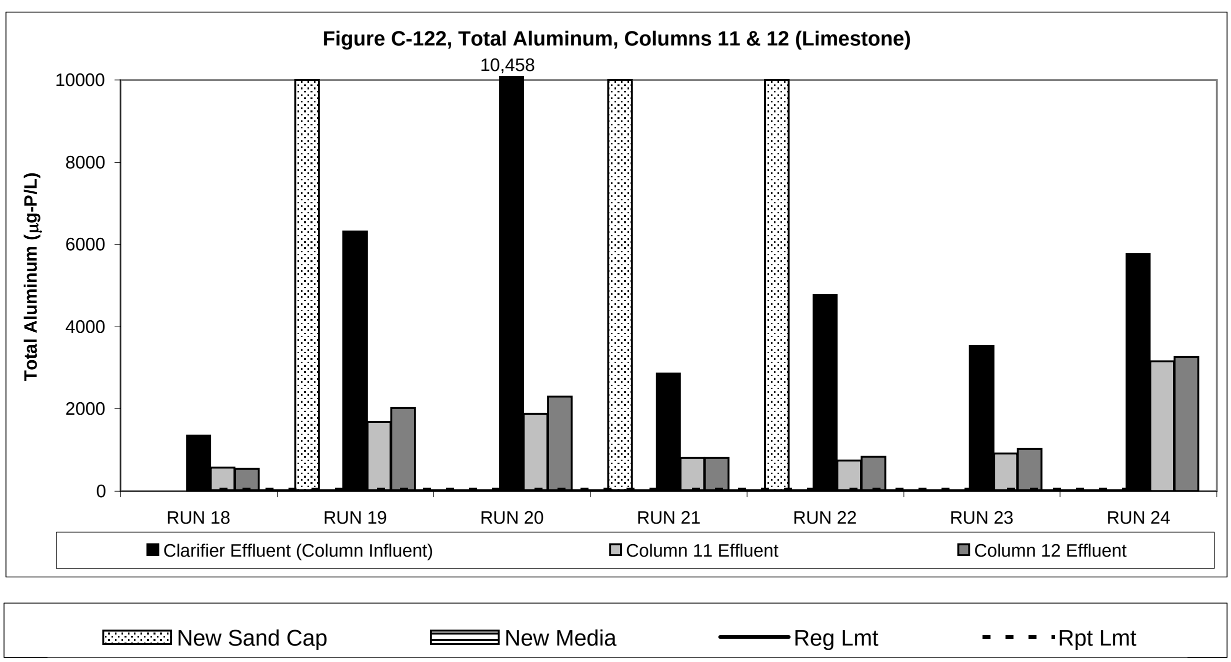


Figure C-122, Total Aluminum, Columns 11 & 12 (Limestone)
10,458
Total Aluminum (µg-P/L)
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 11 Effluent
Column 12 Effluent
New Sand Cap
New Media
Reg Lmt
Rpt Lmt

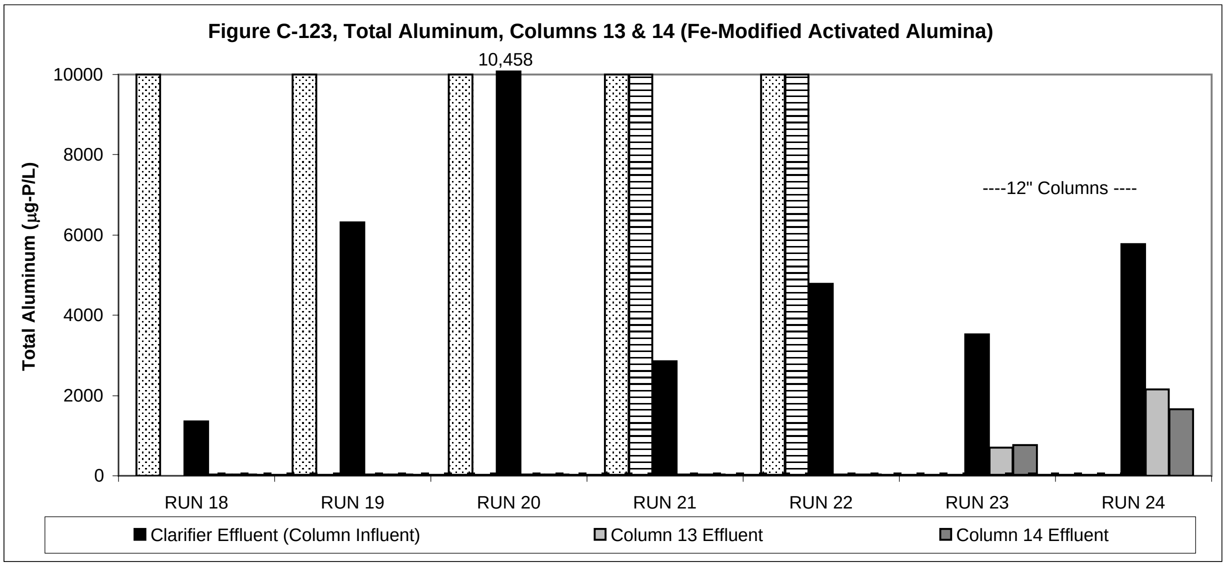


Figure C-123, Total Aluminum, Columns 13 & 14 (Fe-Modified Activated Alumina)
10,458
Total Aluminum (µg-P/L)
0
2000
4000
6000
8000
10000
----12" Columns ----
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 13 Effluent
Column 14 Effluent

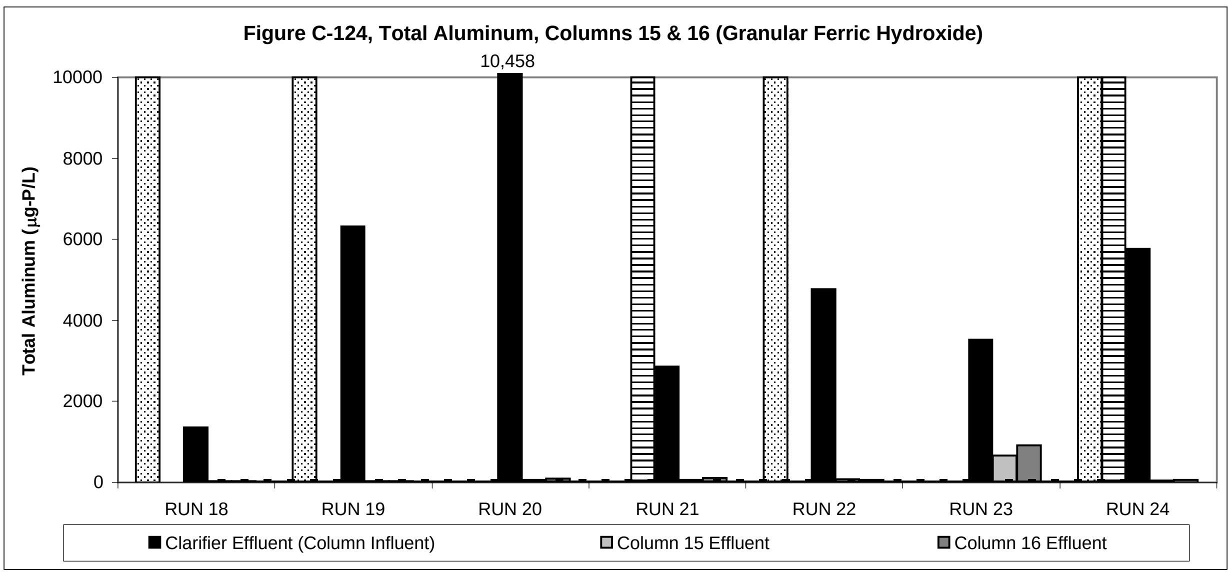


Figure C-124, Total Aluminum, Columns 15 & 16 (Granular Ferric Hydroxide)
10,458
Total Aluminum (µg-P/L)
0
2000
4000
6000
8000
10000
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 15 Effluent
Column 16 Effluent

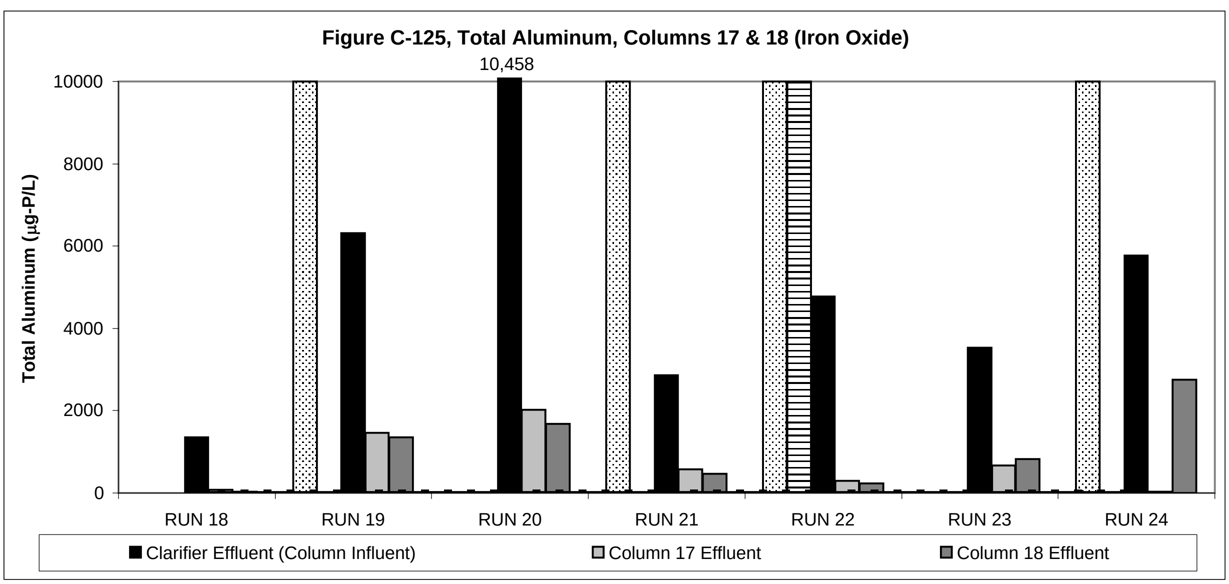


Figure C-125, Total Aluminum, Columns 17 & 18 (Iron Oxide)
10,458
Total Aluminum (µg-P/L)
0
2000
4000
6000
8000
10000
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 17 Effluent
Column 18 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

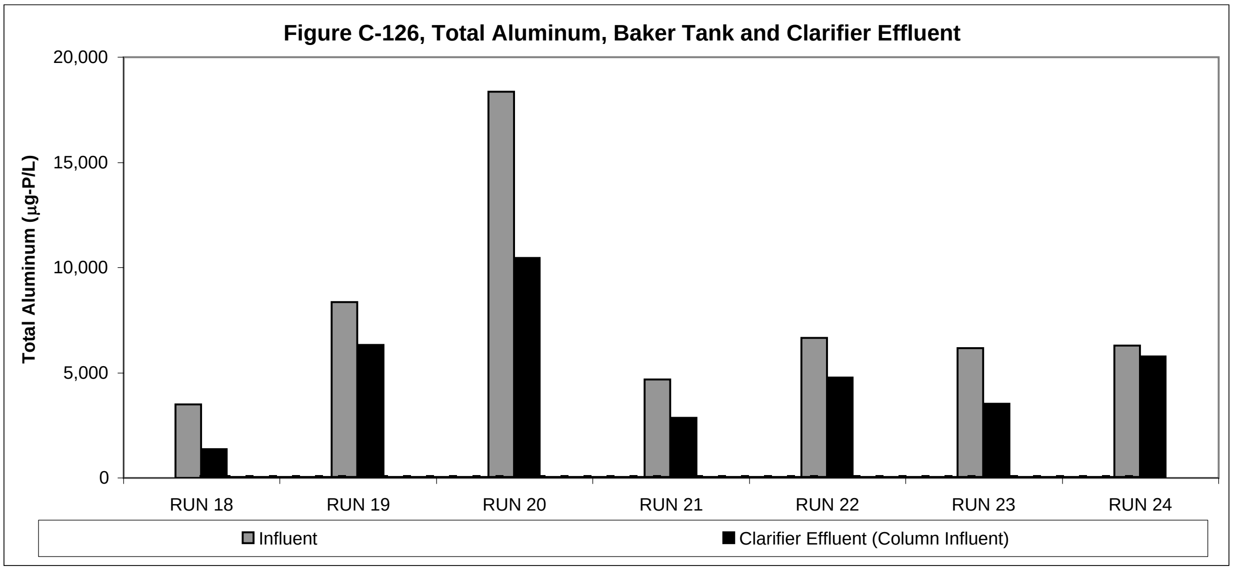


Figure C-126, Total Aluminum, Baker Tank and Clarifier Effluent
Total Aluminum (μg-P/L)
20,000
15,000
10,000
5,000
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Influent
Clarifier Effluent (Column Influent)

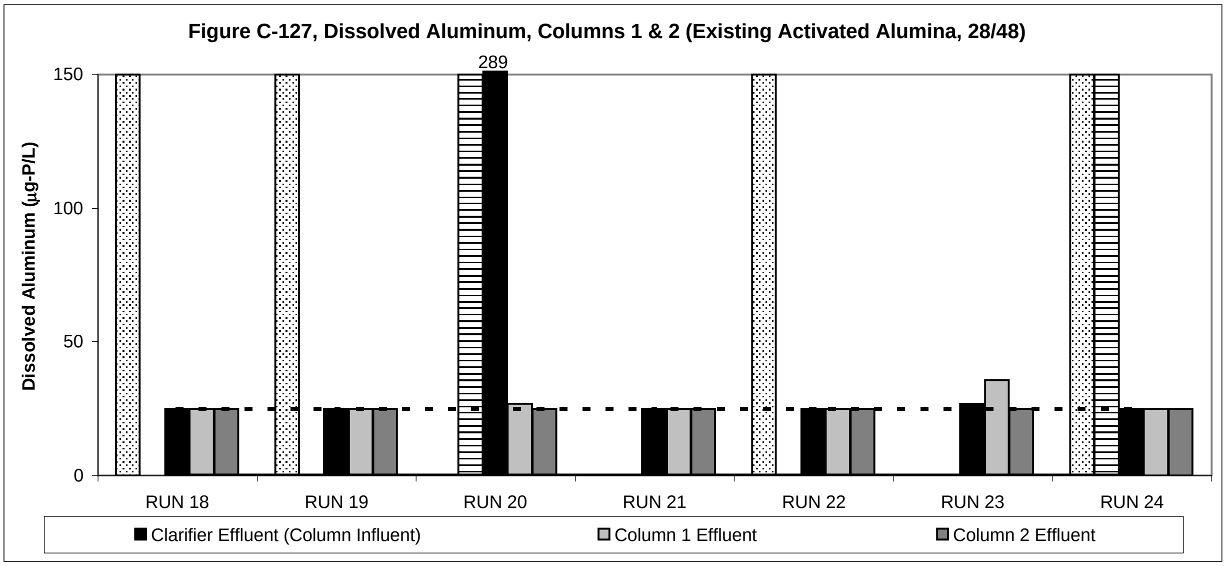


Figure C-127, Dissolved Aluminum, Columns 1 & 2 (Existing Activated Alumina, 28/48)
289
Dissolved Aluminum (µg-P/L)
0
50
100
150
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 1 Effluent
Column 2 Effluent

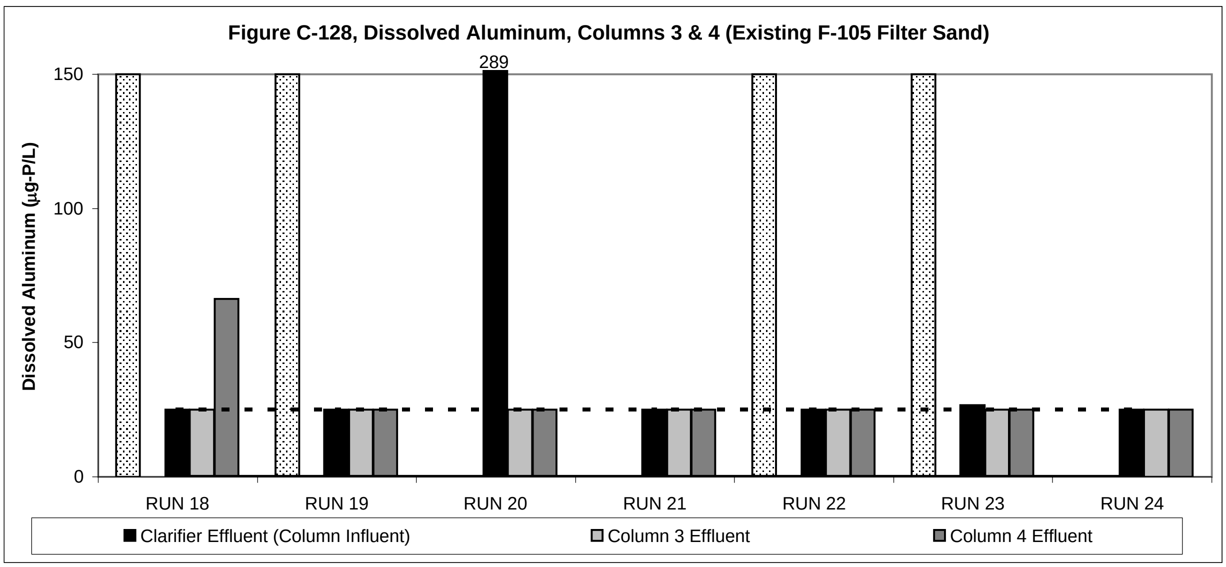


Figure C-128, Dissolved Aluminum, Columns 3 & 4 (Existing F-105 Filter Sand)
289
Dissolved Aluminum (µg-P/L)
0
50
100
150
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 3 Effluent
Column 4 Effluent

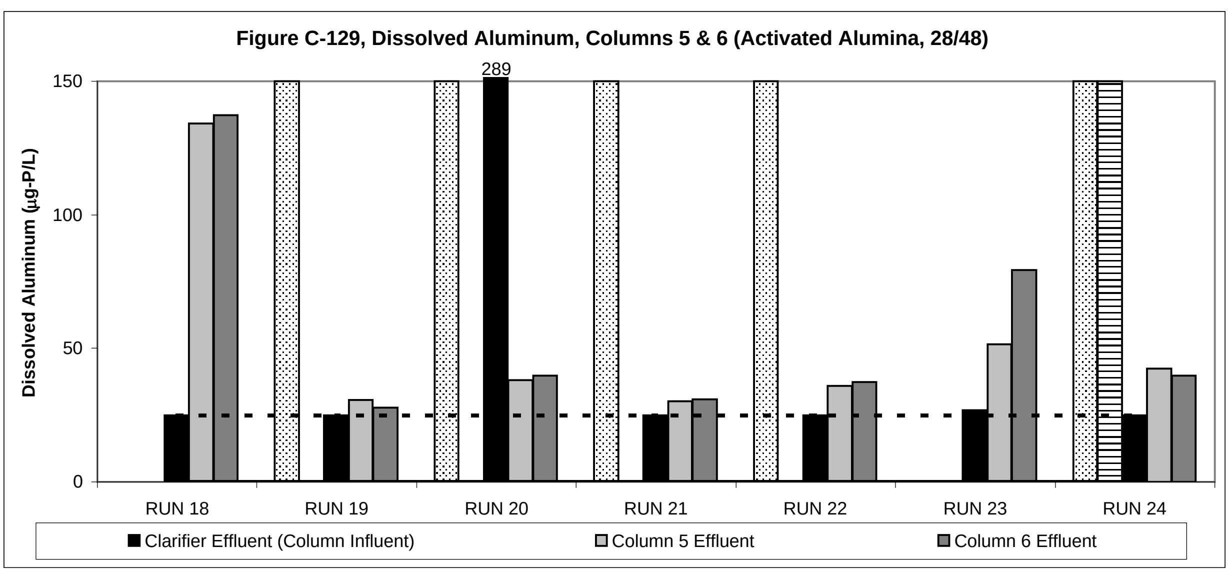


Figure C-129, Dissolved Aluminum, Columns 5 & 6 (Activated Alumina, 28/48)
289
Dissolved Aluminum (µg-P/L)
0
50
100
150
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 5 Effluent
Column 6 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

Figure C-130, Dissolved Aluminum, Columns 7 & 8 (Activated Alumina, 14/28)

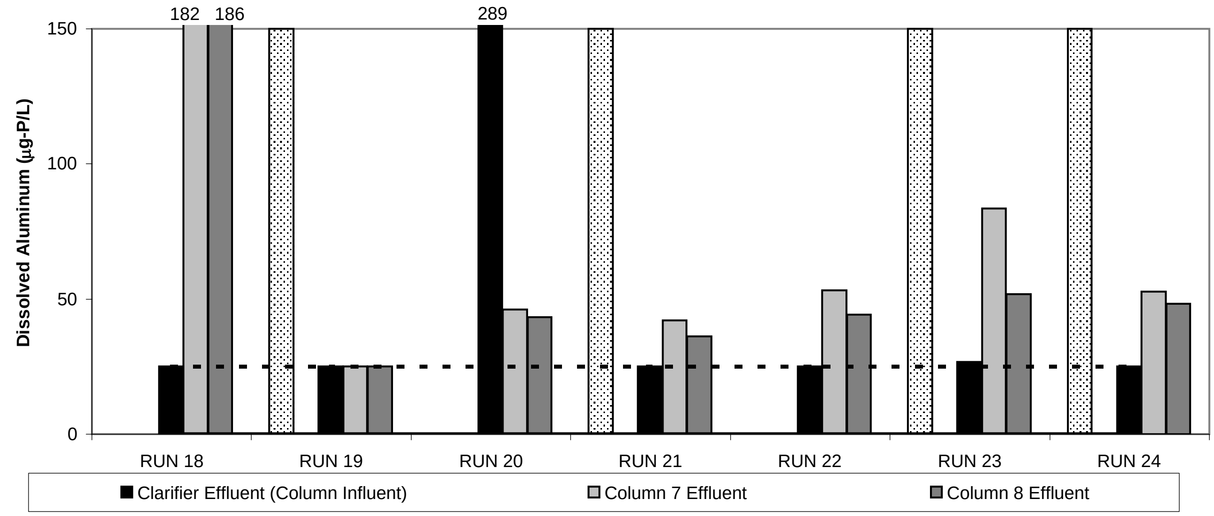


Figure C-131, Dissolved Aluminum, Columns 9 & 10 (Superior 30 Sand)

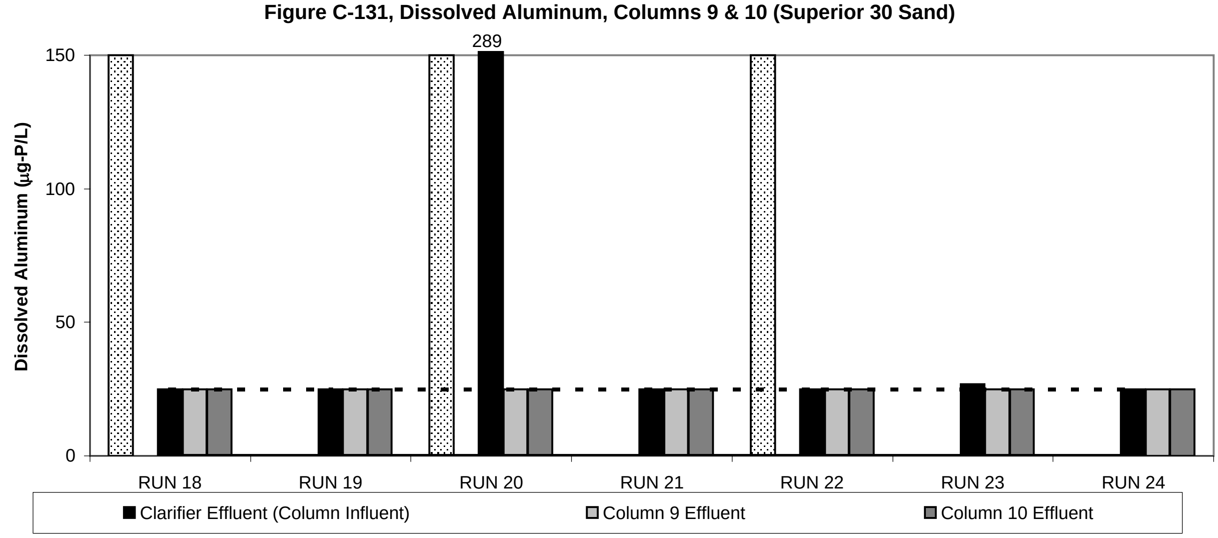
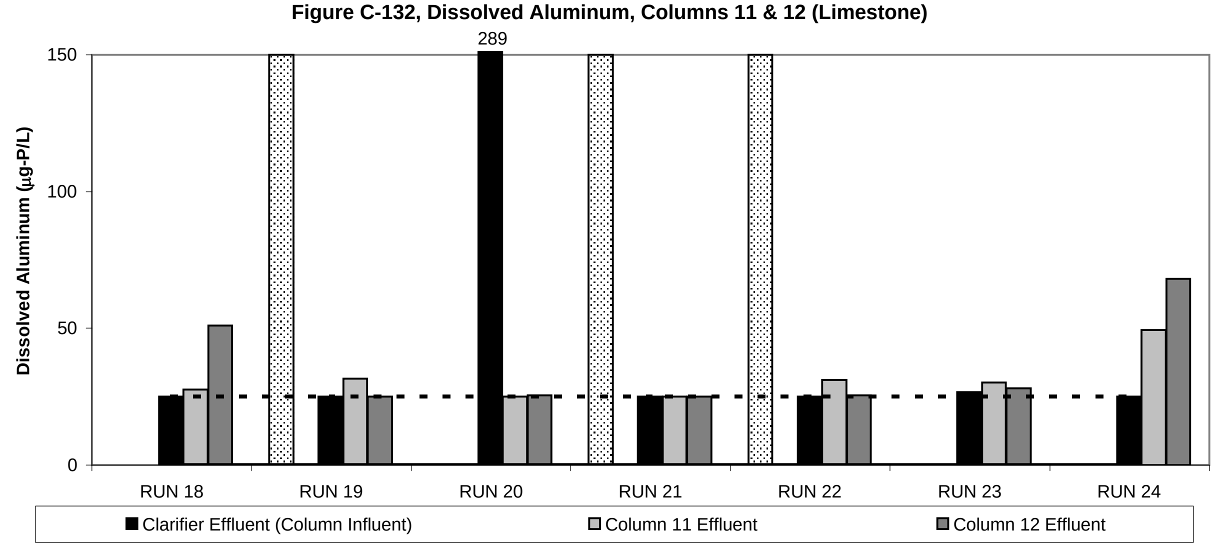


Figure C-132, Dissolved Aluminum, Columns 11 & 12 (Limestone)



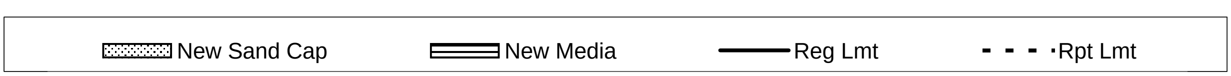


Figure C-133, Dissolved Aluminum, Columns 13 & 14 (Fe-Modified Activated Alumina)

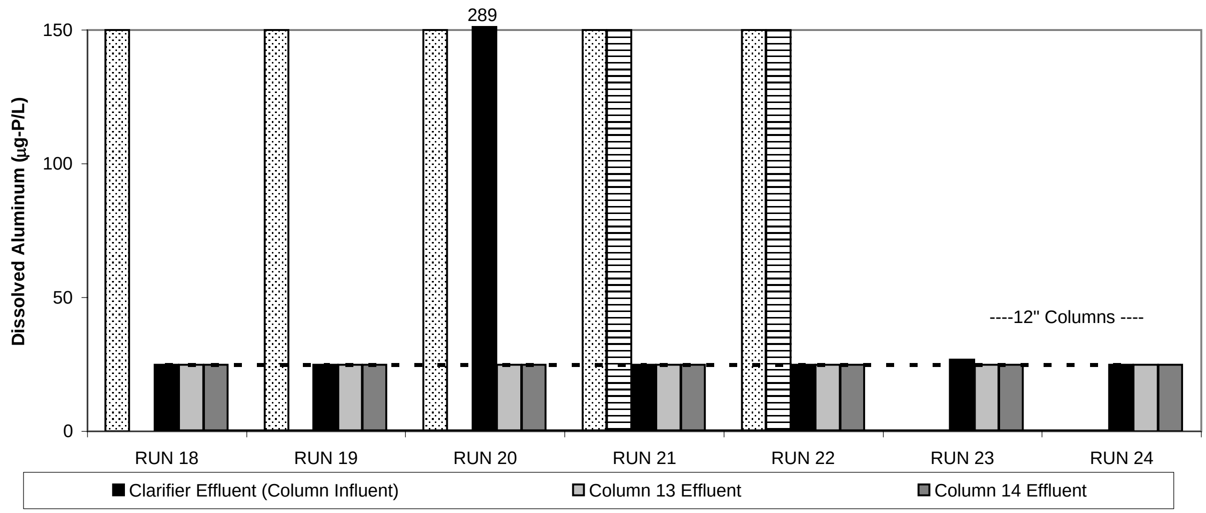


Figure C-134, Dissolved Aluminum, Columns 15 & 16 (Granular Ferric Hydroxide)

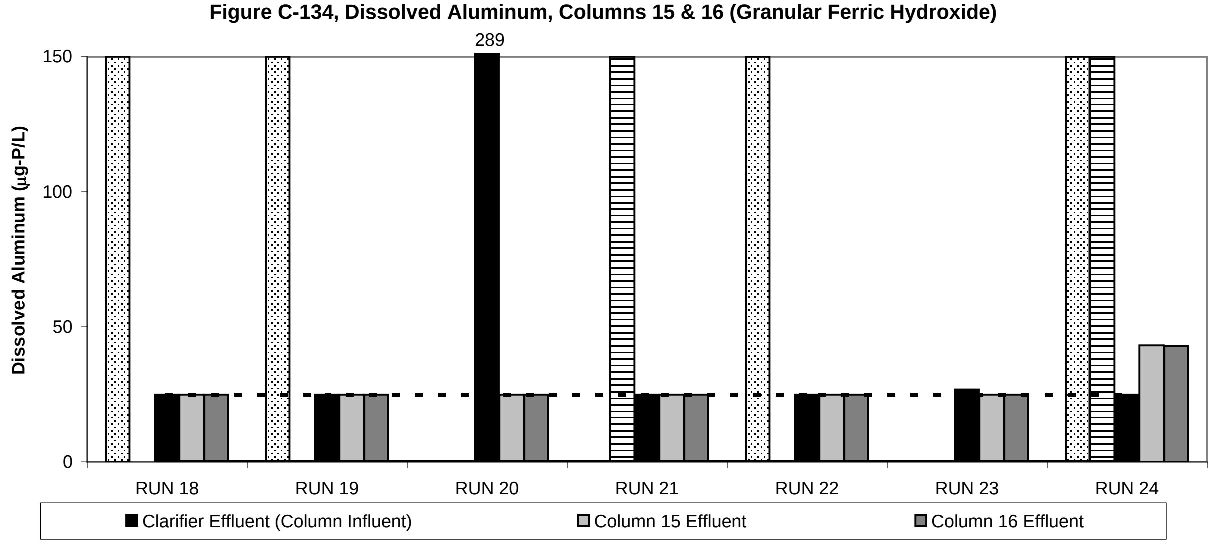


Figure C-135, Dissolved Aluminum, Columns 17 & 18 (Iron Oxide)

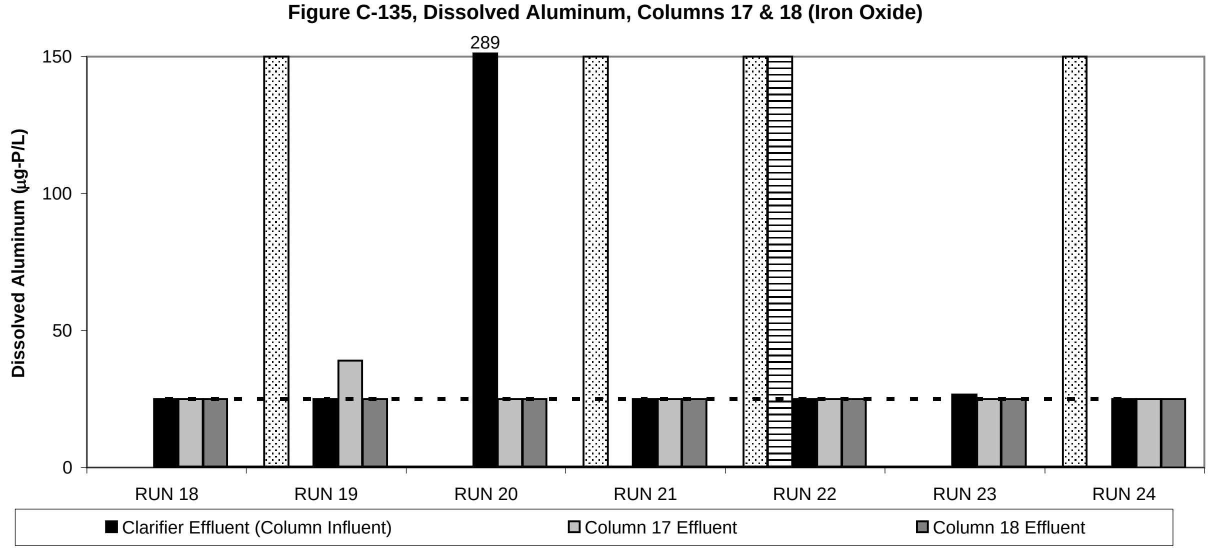
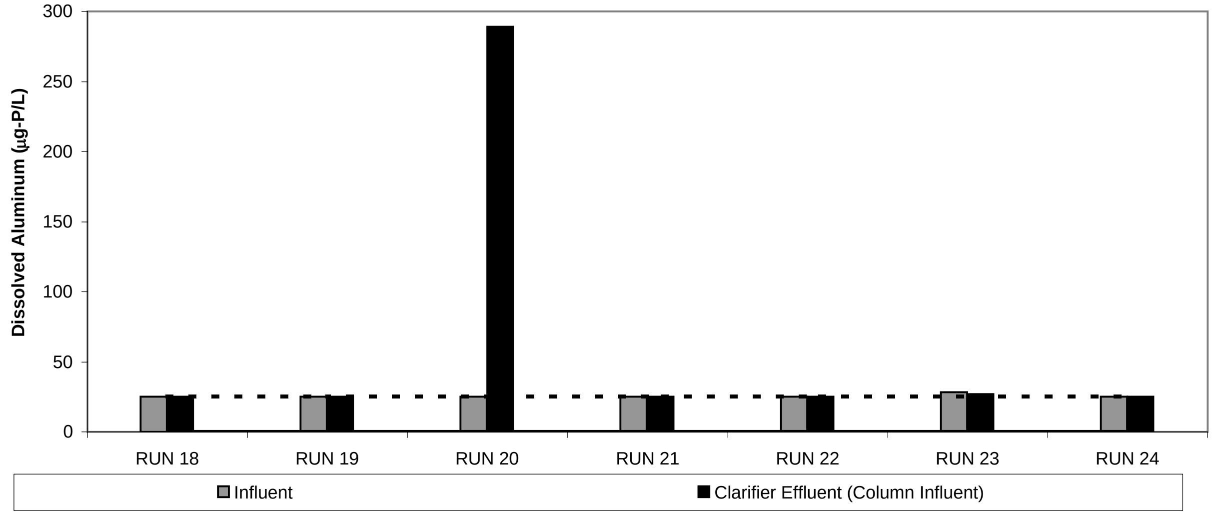


Figure C-136, Dissolved Aluminum, Baker Tank and Clarifier Effluent



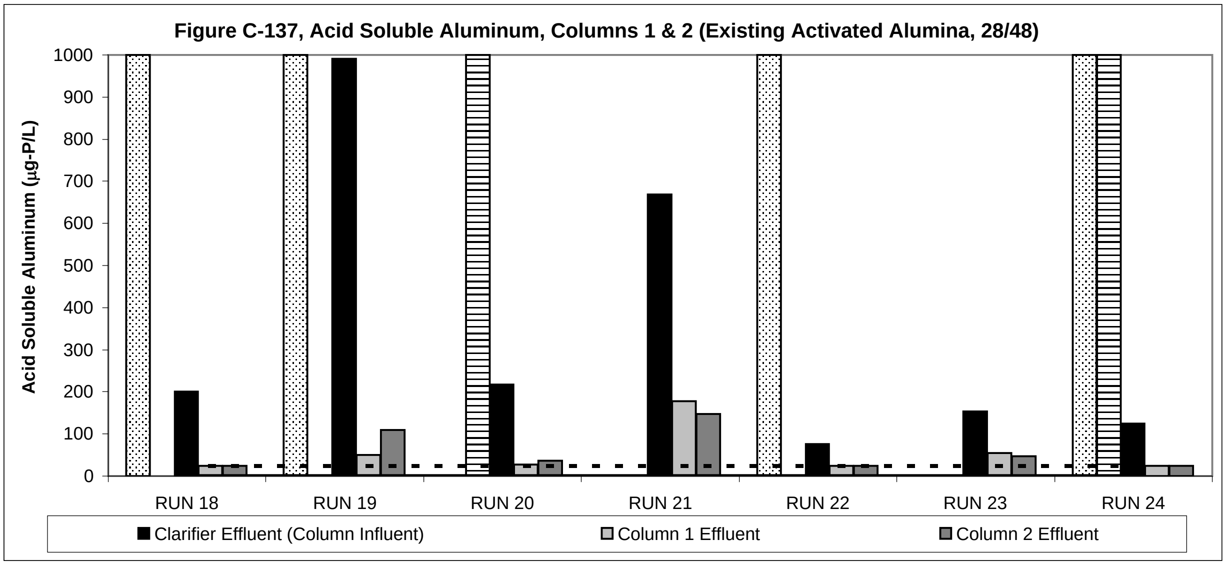


Figure C-137, Acid Soluble Aluminum, Columns 1 & 2 (Existing Activated Alumina, 28/48)
Acid Soluble Aluminum (µg-P/L)
1000
900
800
700
600
500
400
300
200
100
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 1 Effluent
Column 2 Effluent

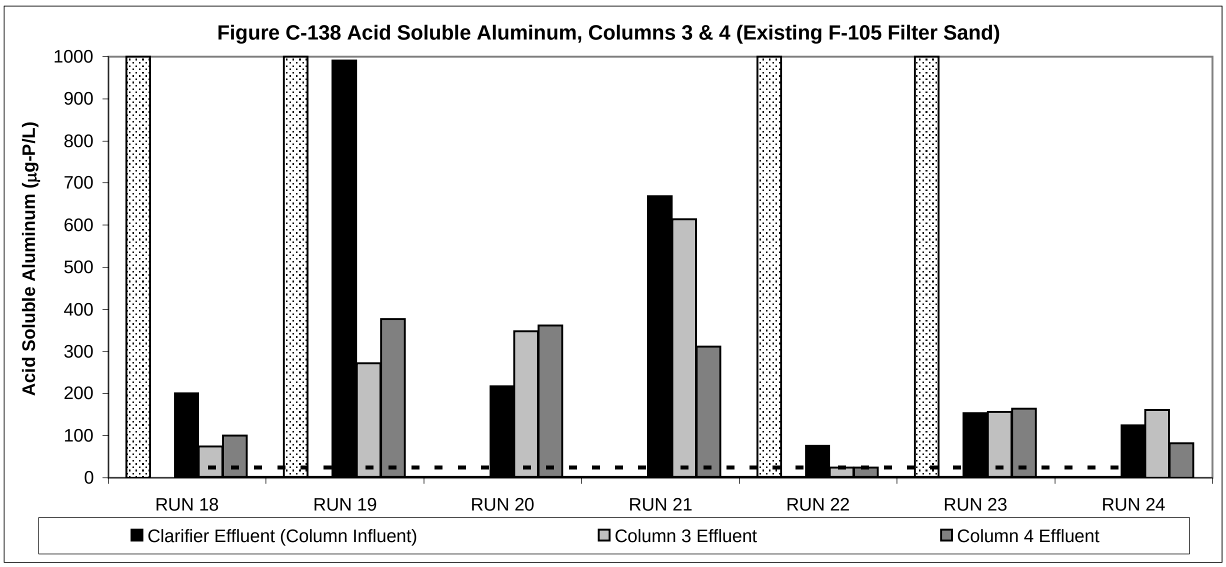


Figure C-138 Acid Soluble Aluminum, Columns 3 & 4 (Existing F-105 Filter Sand)
Acid Soluble Aluminum (µg-P/L)
1000
900
800
700
600
500
400
300
200
100
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 3 Effluent
Column 4 Effluent

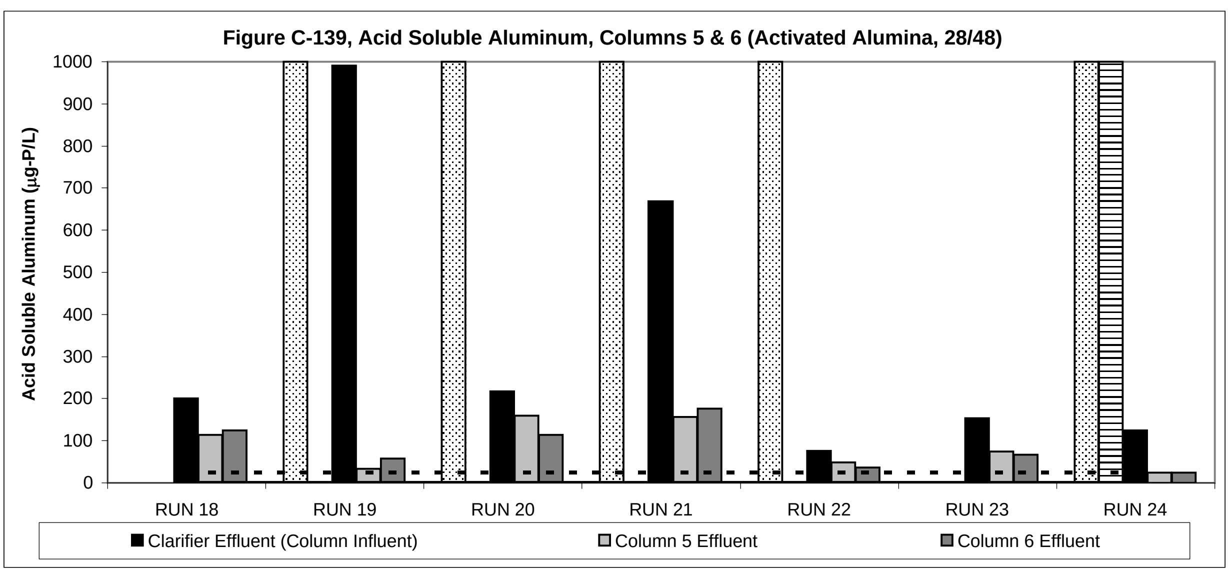


Figure C-139, Acid Soluble Aluminum, Columns 5 & 6 (Activated Alumina, 28/48)
Acid Soluble Aluminum (µg-P/L)
1000
900
800
700
600
500
400
300
200
100
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 5 Effluent
Column 6 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

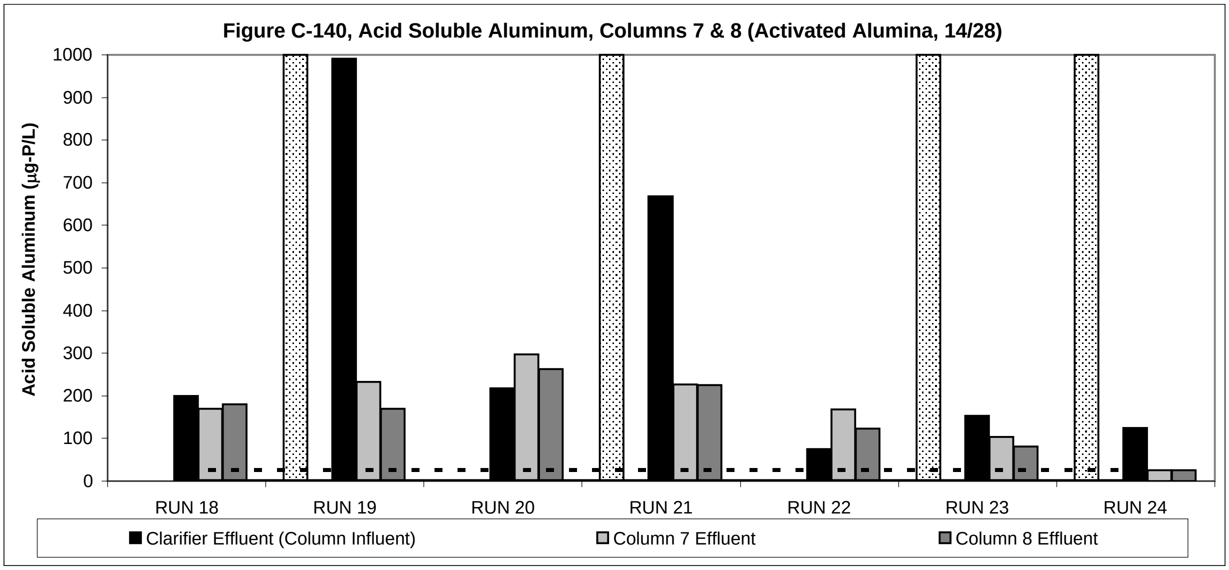


Figure C-140, Acid Soluble Aluminum, Columns 7 & 8 (Activated Alumina, 14/28)
Acid Soluble Aluminum (µg-P/L)
1000
900
800
700
600
500
400
300
200
100
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 7 Effluent
Column 8 Effluent

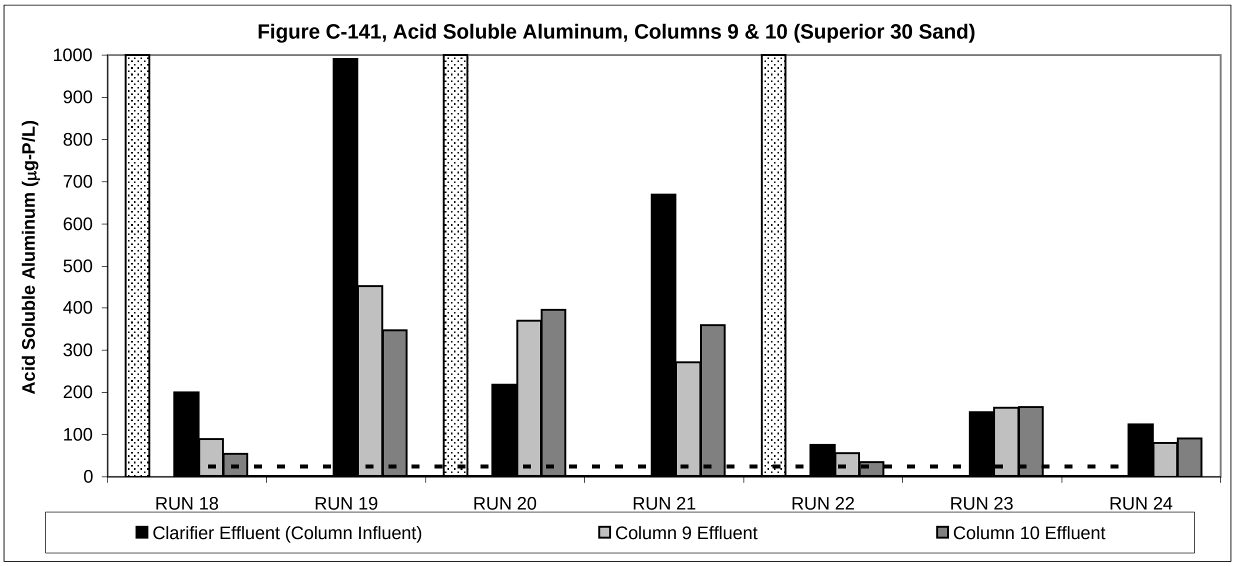


Figure C-141, Acid Soluble Aluminum, Columns 9 & 10 (Superior 30 Sand)
Acid Soluble Aluminum (µg-P/L)
1000
900
800
700
600
500
400
300
200
100
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 9 Effluent
Column 10 Effluent

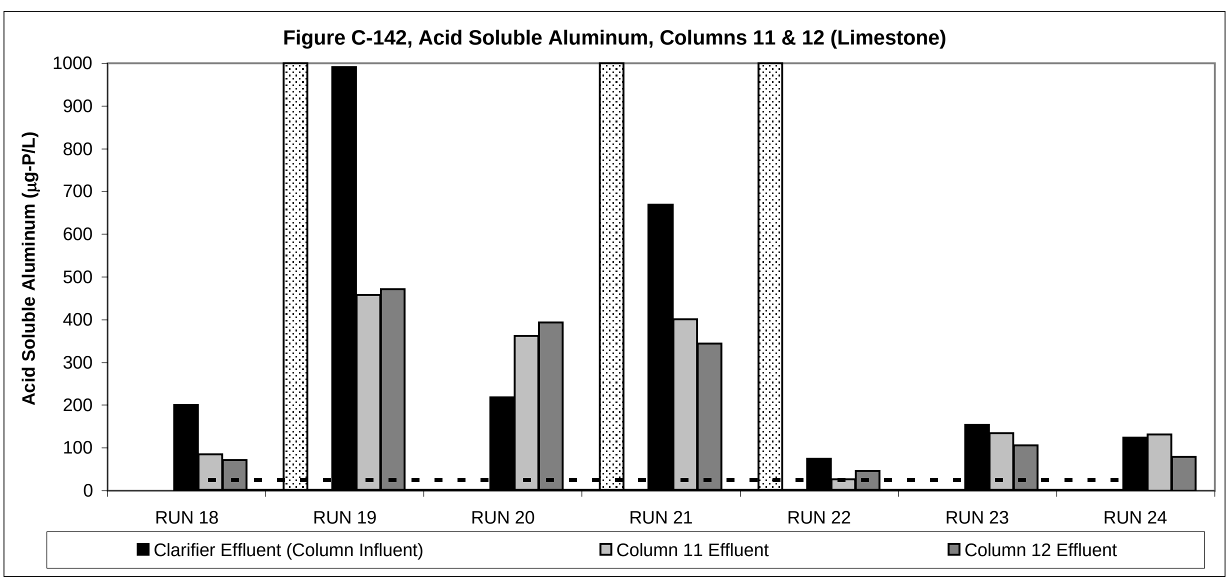


Figure C-142, Acid Soluble Aluminum, Columns 11 & 12 (Limestone)
Acid Soluble Aluminum (µg-P/L)
1000
900
800
700
600
500
400
300
200
100
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 11 Effluent
Column 12 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

Figure C-143, Acid Soluble Aluminum, Columns 13 & 14 (Fe-Modified Activated Alumina)

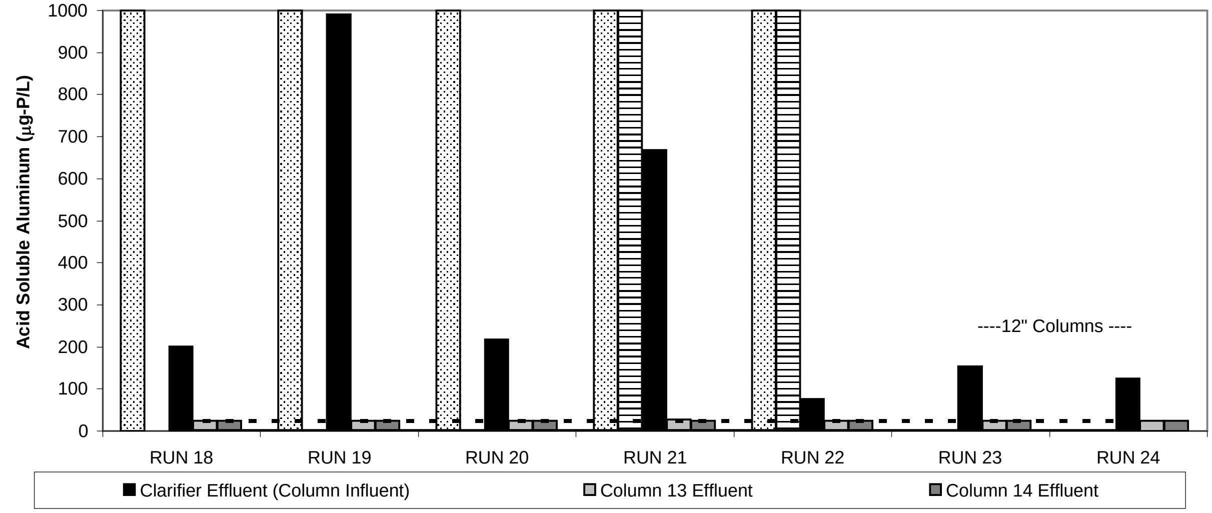


Figure C-144, Acid Soluble Aluminum, Columns 15 & 16 (Granular Ferric Hydroxide)

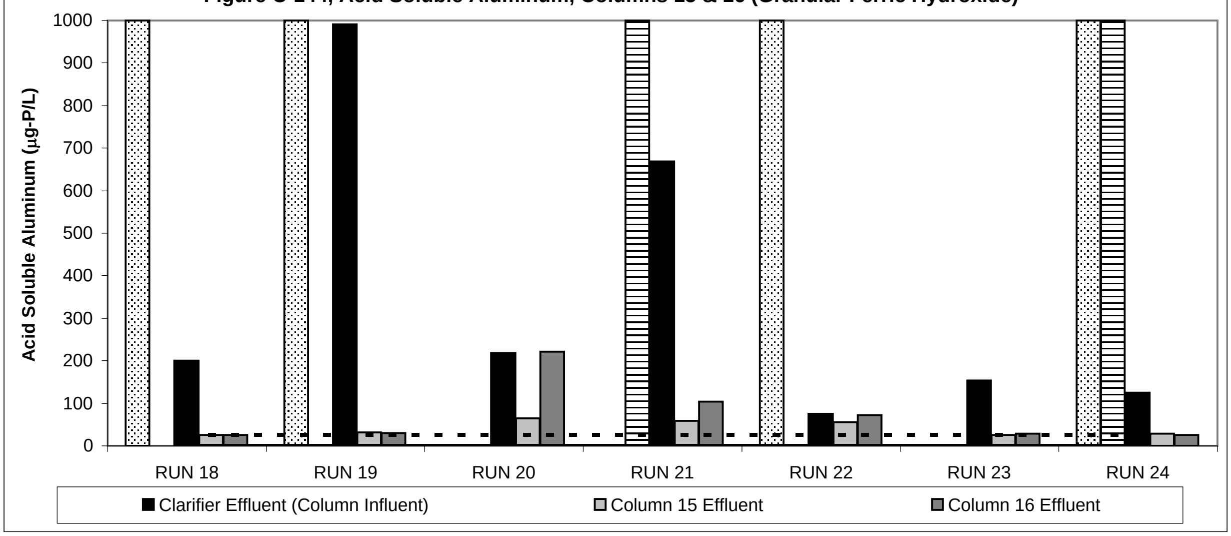
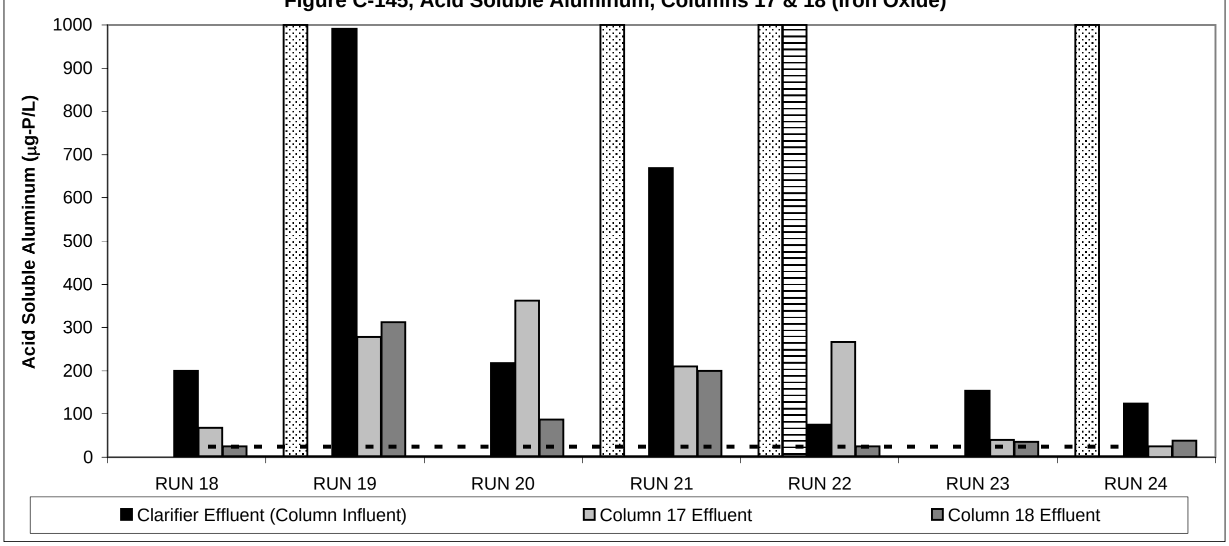


Figure C-145, Acid Soluble Aluminum, Columns 17 & 18 (Iron Oxide)



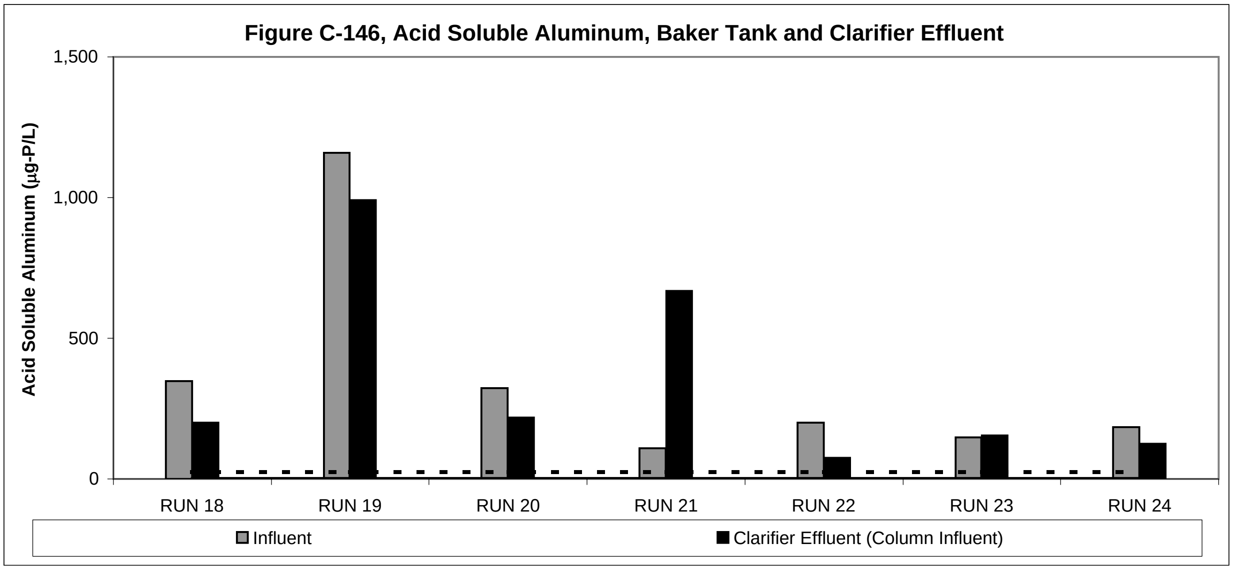


Figure C-146, Acid Soluble Aluminum, Baker Tank and Clarifier Effluent
Acid Soluble Aluminum (µg-P/L)
1,500
1,000
500
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Influent
Clarifier Effluent (Column Influent)

Figure C-147, pH, Columns 1 & 2 (Existing Activated Alumina, 28/48)

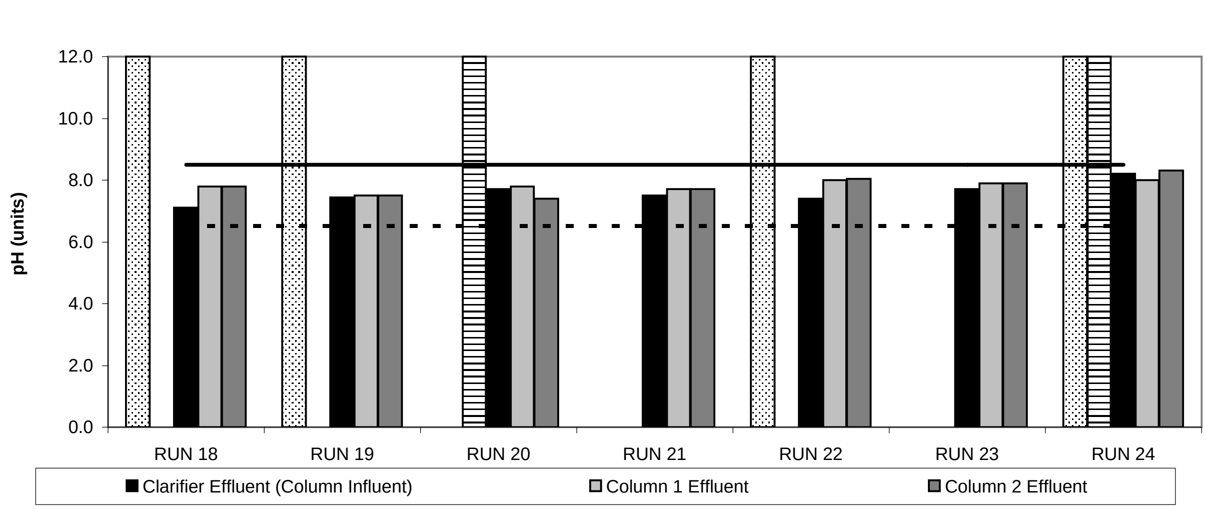


Figure C-148, pH, Columns 3 & 4 (Existing F-105 Filter Sand)

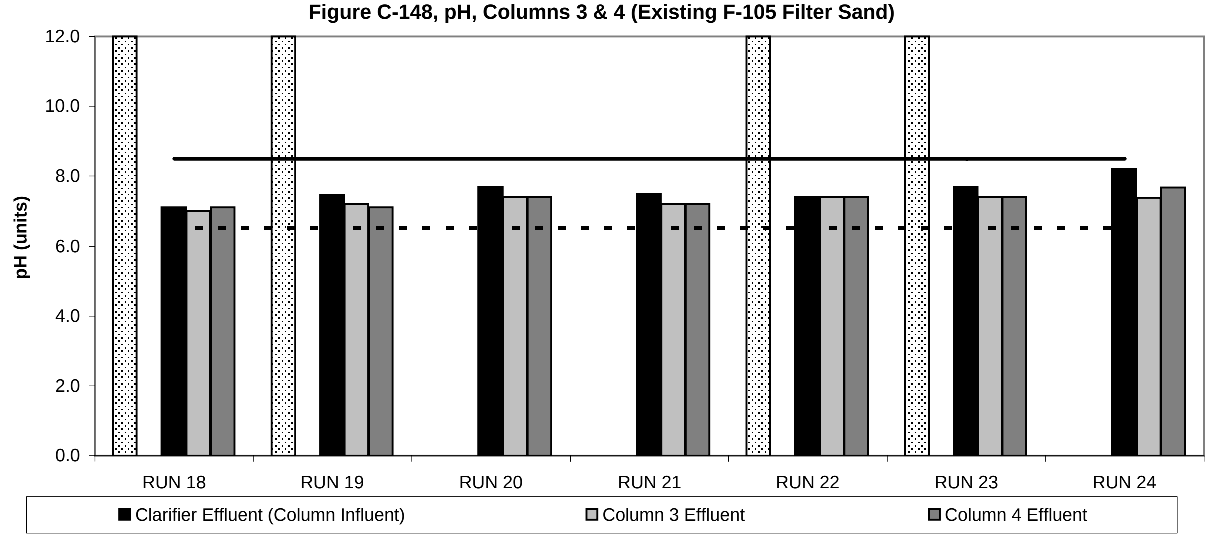
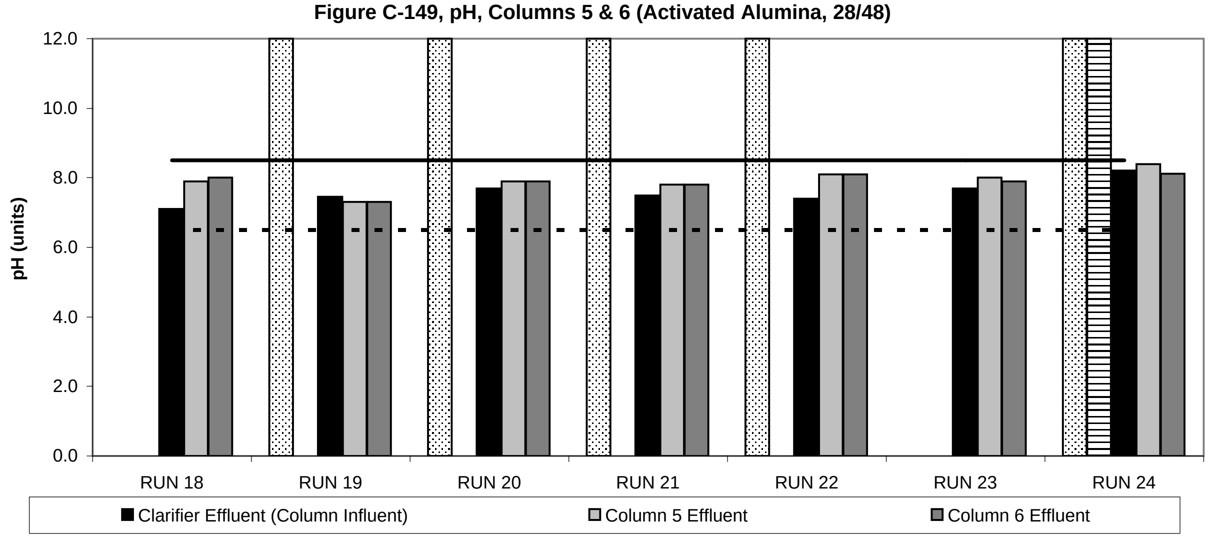


Figure C-149, pH, Columns 5 & 6 (Activated Alumina, 28/48)



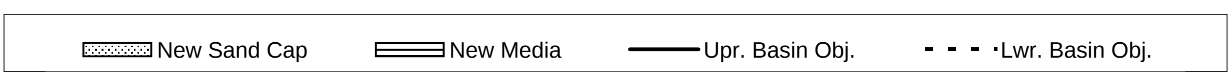


Figure C-150, pH, Columns 7 & 8 (Activated Alumina, 14/28)

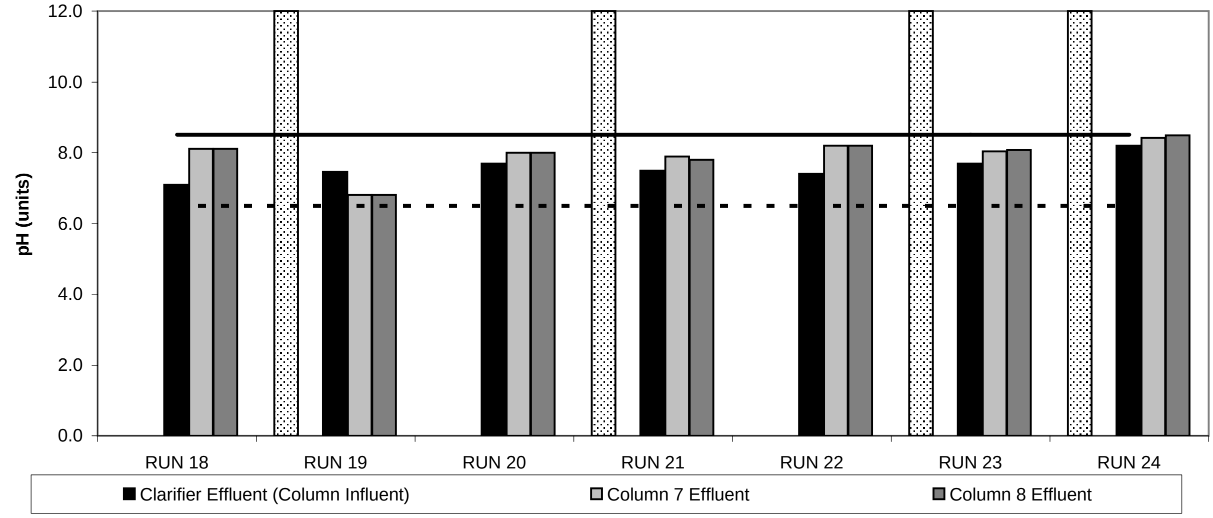


Figure C-151, pH, Columns 9 & 10 (Superior 30 Sand)

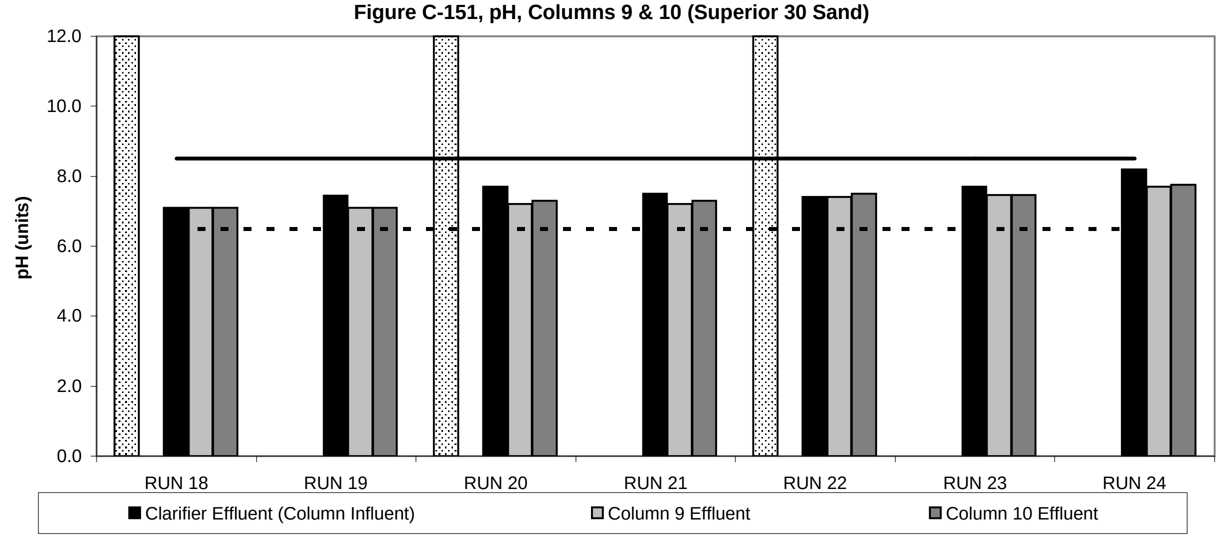
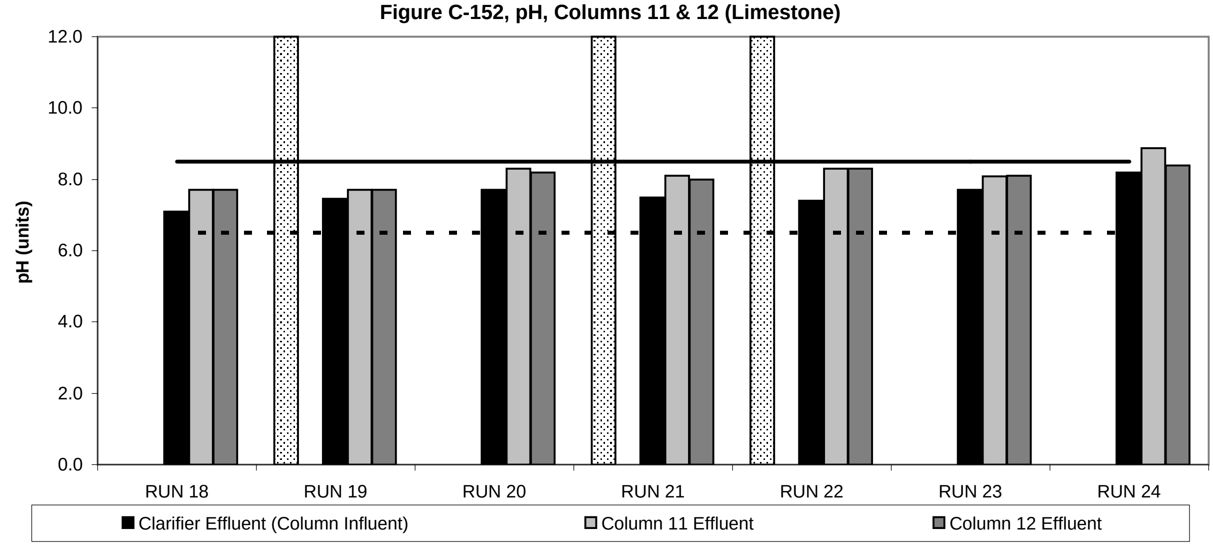
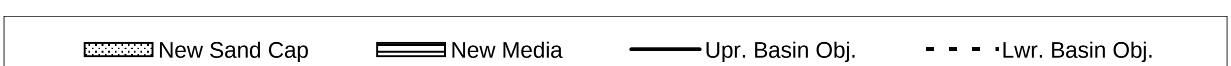


Figure C-152, pH, Columns 11 & 12 (Limestone)





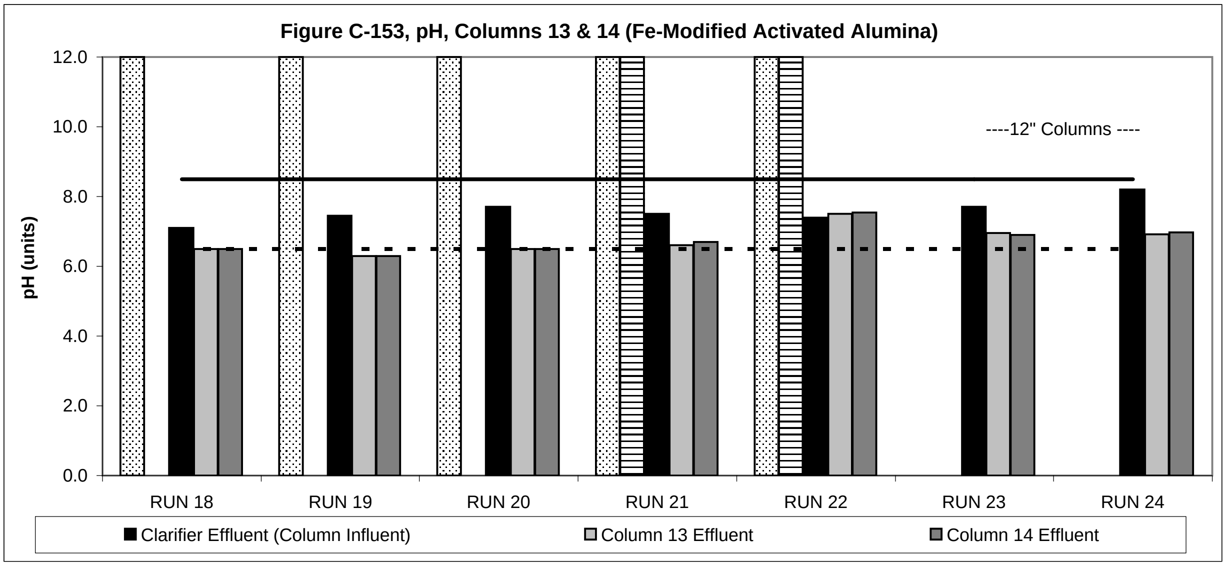


Figure C-153, pH, Columns 13 & 14 (Fe-Modified Activated Alumina)
pH (units)
12.0
10.0
8.0
6.0
4.0
2.0
0.0
----12" Columns ----
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 13 Effluent
Column 14 Effluent

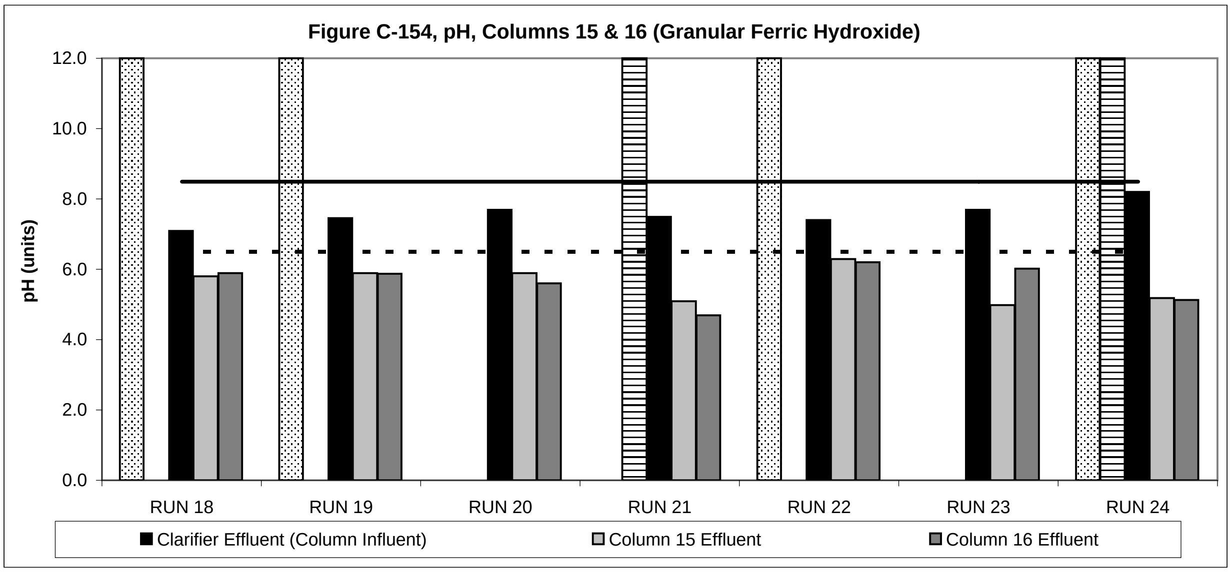


Figure C-154, pH, Columns 15 & 16 (Granular Ferric Hydroxide)
pH (units)
12.0
10.0
8.0
6.0
4.0
2.0
0.0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 15 Effluent
Column 16 Effluent

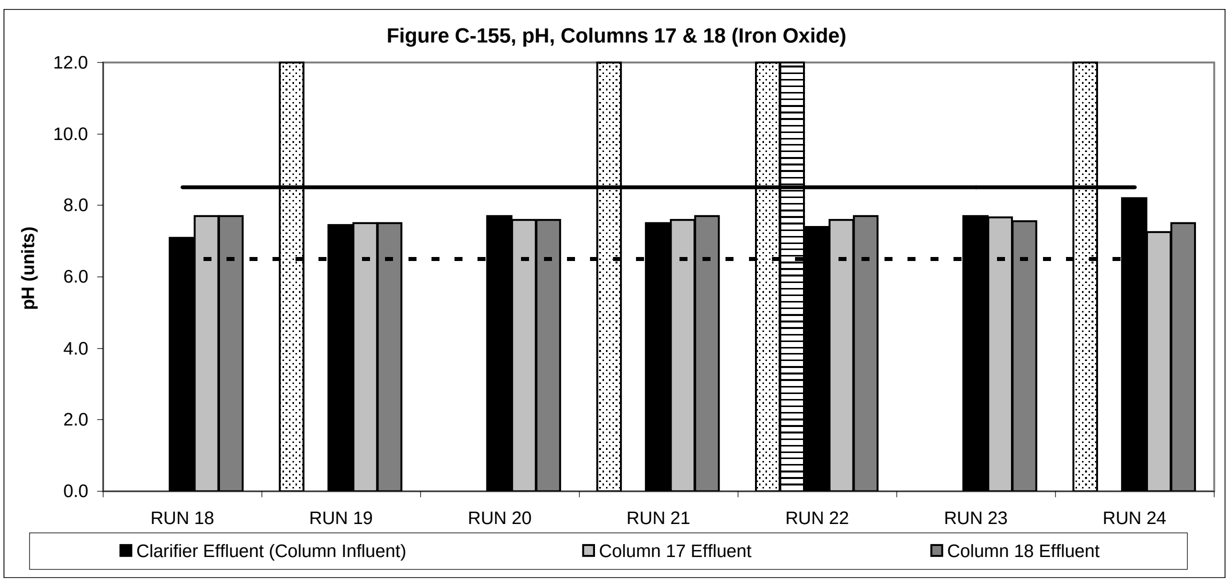
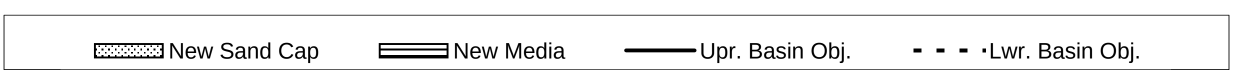


Figure C-155, pH, Columns 17 & 18 (Iron Oxide)
pH (units)
12.0
10.0
8.0
6.0
4.0
2.0
0.0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 17 Effluent
Column 18 Effluent


New Sand Cap
New Media
Upr. Basin Obj.
Lwr. Basin Obj.

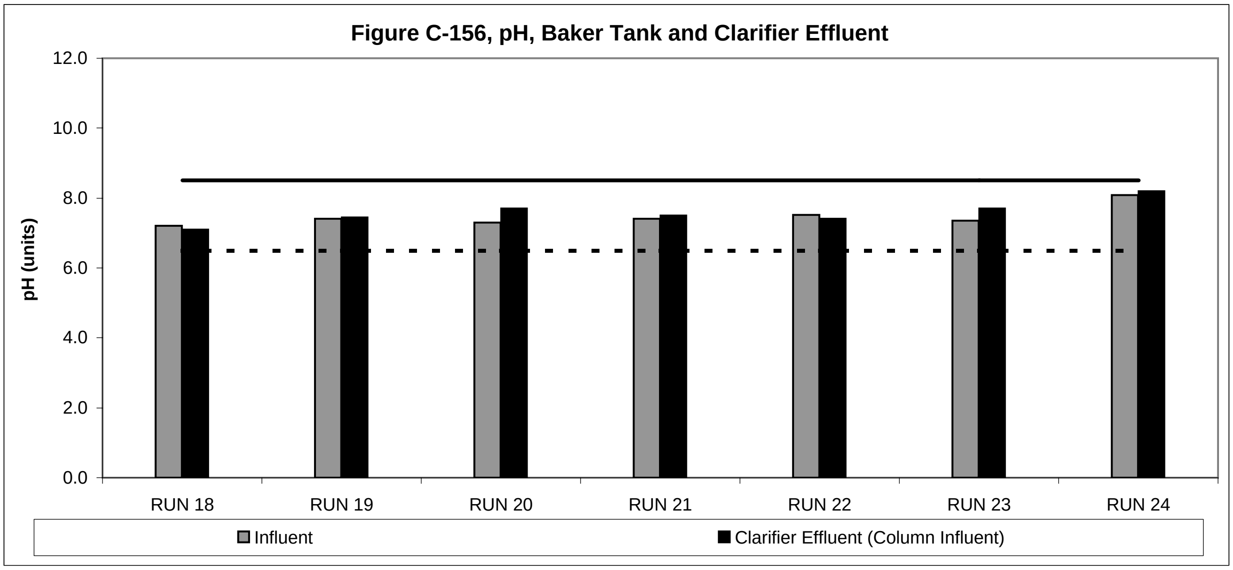


Figure C-156, pH, Baker Tank and Clarifier Effluent
pH (units)
12.0
10.0
8.0
6.0
4.0
2.0
0.0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Influent
Clarifier Effluent (Column Influent)

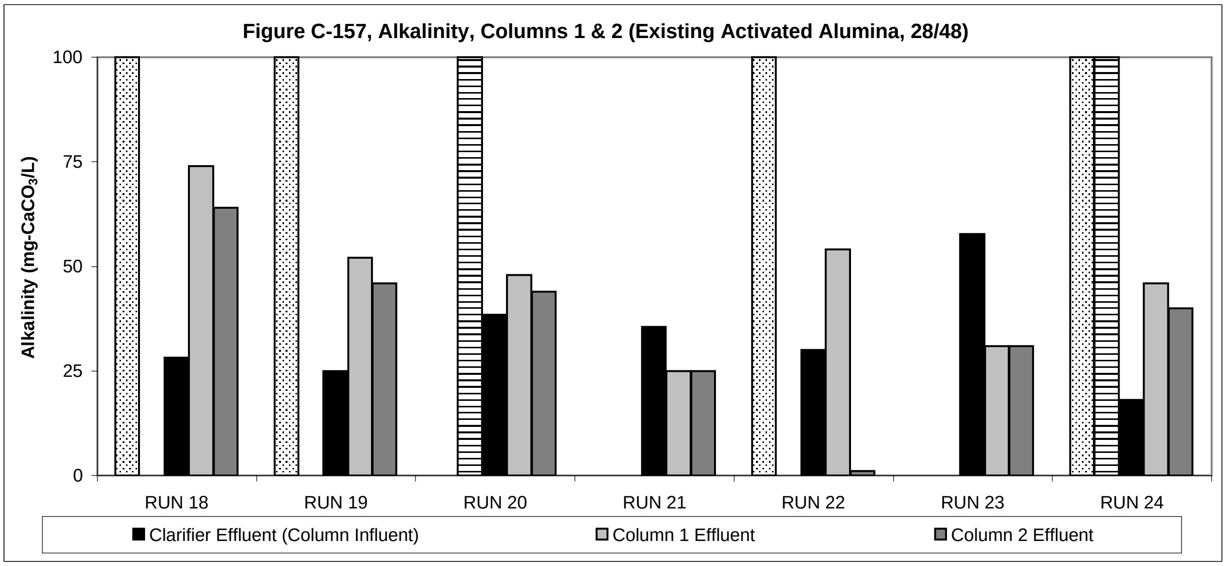


Figure C-157, Alkalinity, Columns 1 & 2 (Existing Activated Alumina, 28/48)
Alkalinity (mg-CaCO3/L)
100
75
50
25
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 1 Effluent
Column 2 Effluent

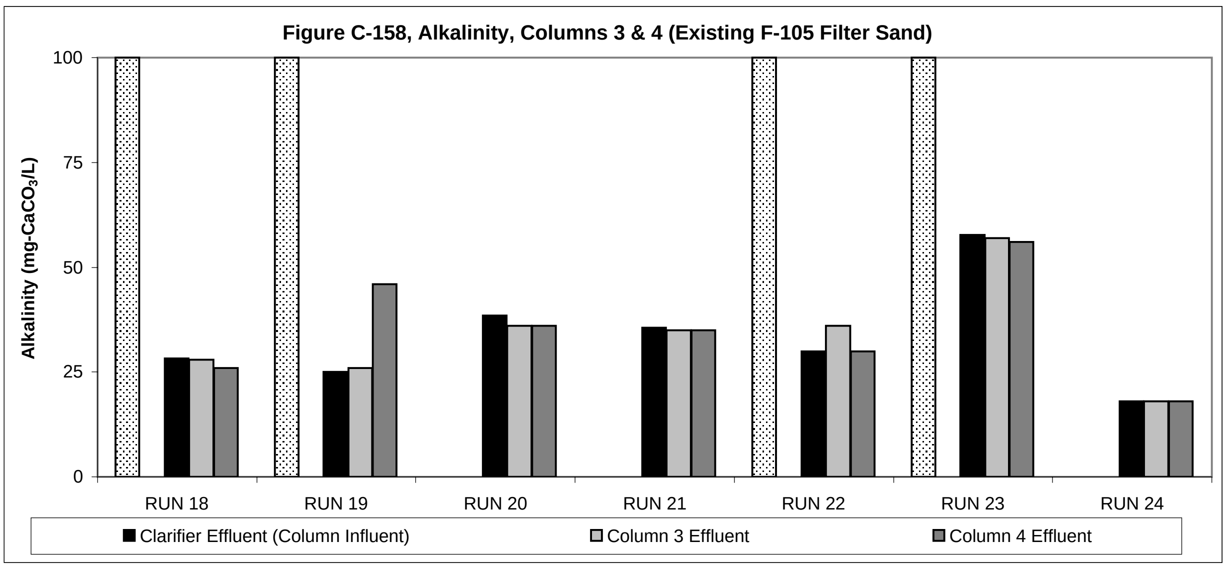


Figure C-158, Alkalinity, Columns 3 & 4 (Existing F-105 Filter Sand)
Alkalinity (mg-CaCO3/L)
100
75
50
25
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 3 Effluent
Column 4 Effluent

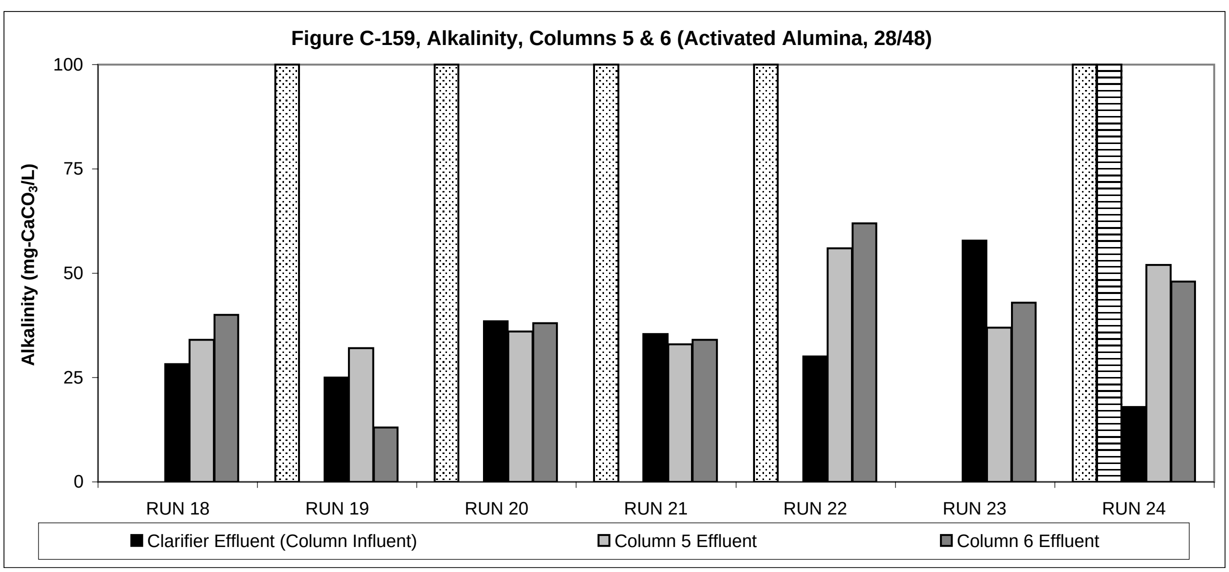


Figure C-159, Alkalinity, Columns 5 & 6 (Activated Alumina, 28/48)
Alkalinity (mg-CaCO3/L)
100
75
50
25
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 5 Effluent
Column 6 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

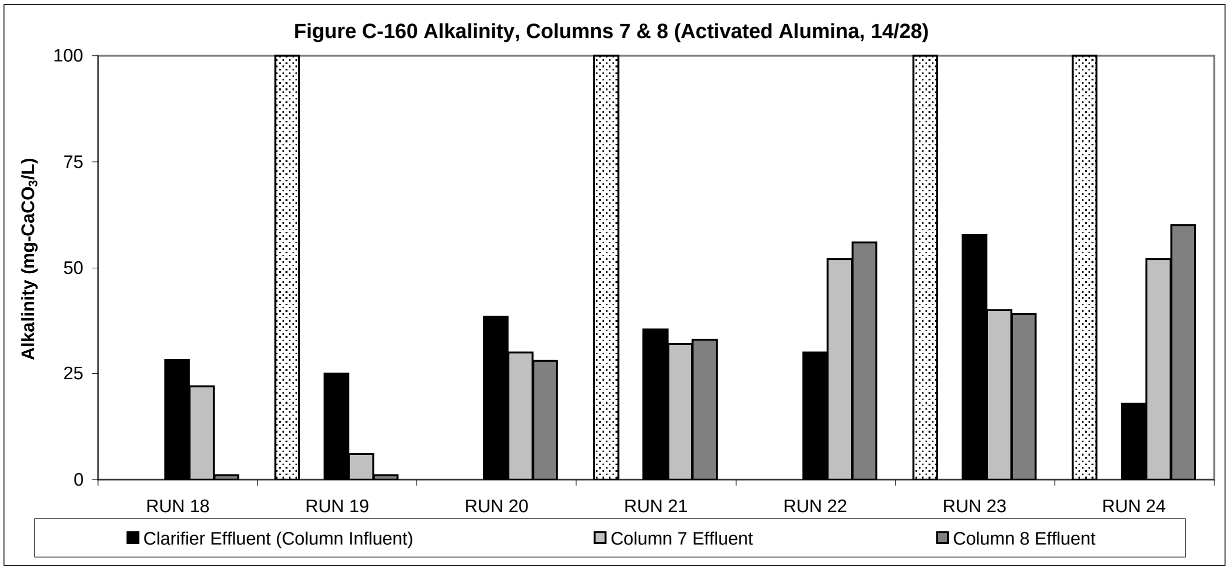


Figure C-160 Alkalinity, Columns 7 & 8 (Activated Alumina, 14/28)
Alkalinity (mg-CaCO3/L)
100
75
50
25
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 7 Effluent
Column 8 Effluent

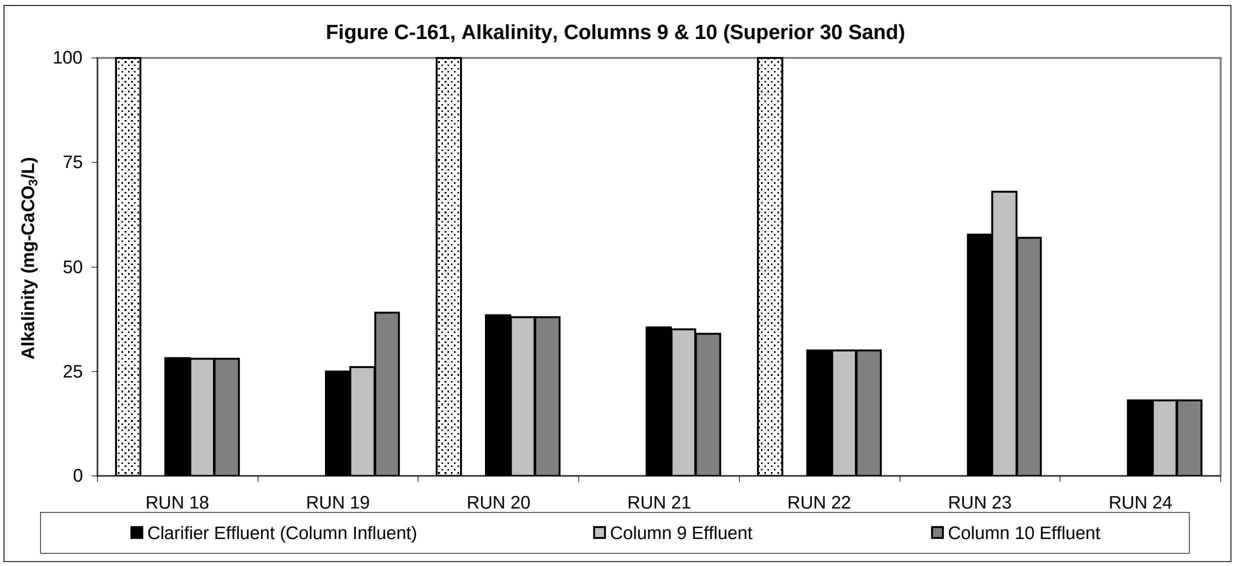


Figure C-161, Alkalinity, Columns 9 & 10 (Superior 30 Sand)
Alkalinity (mg-CaCO3/L)
100
75
50
25
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 9 Effluent
Column 10 Effluent

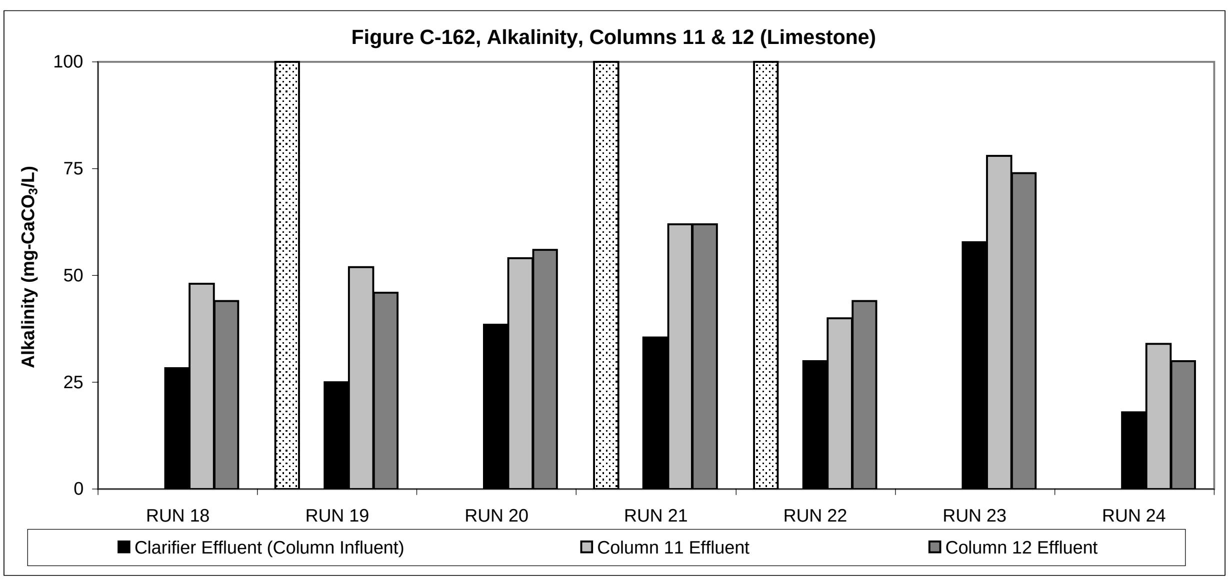


Figure C-162, Alkalinity, Columns 11 & 12 (Limestone)
Alkalinity (mg-CaCO3/L)
100
75
50
25
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 11 Effluent
Column 12 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

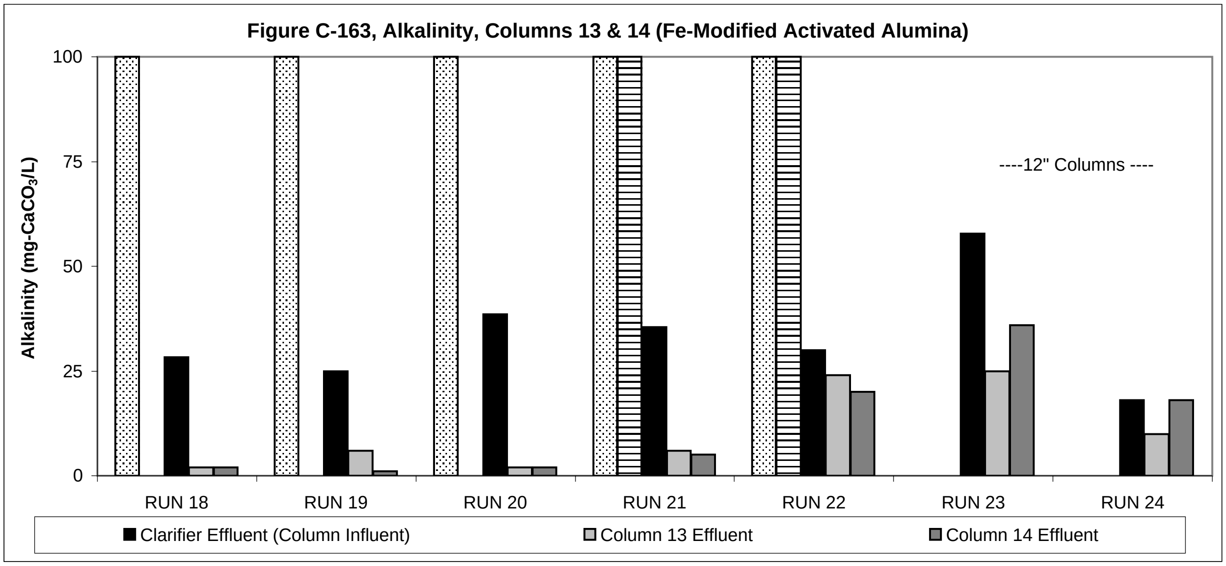


Figure C-163, Alkalinity, Columns 13 & 14 (Fe-Modified Activated Alumina)
Alkalinity (mg-CaCO3/L)
100
75
50
25
0
----12" Columns ----
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 13 Effluent
Column 14 Effluent

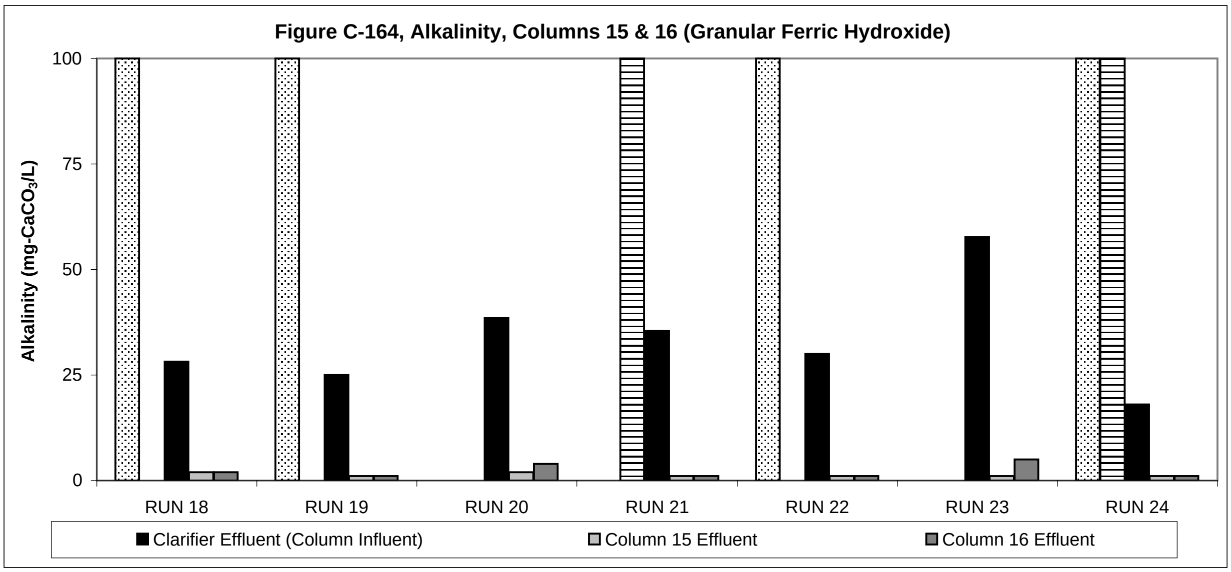


Figure C-164, Alkalinity, Columns 15 & 16 (Granular Ferric Hydroxide)
Alkalinity (mg-CaCO3/L)
100
75
50
25
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 15 Effluent
Column 16 Effluent

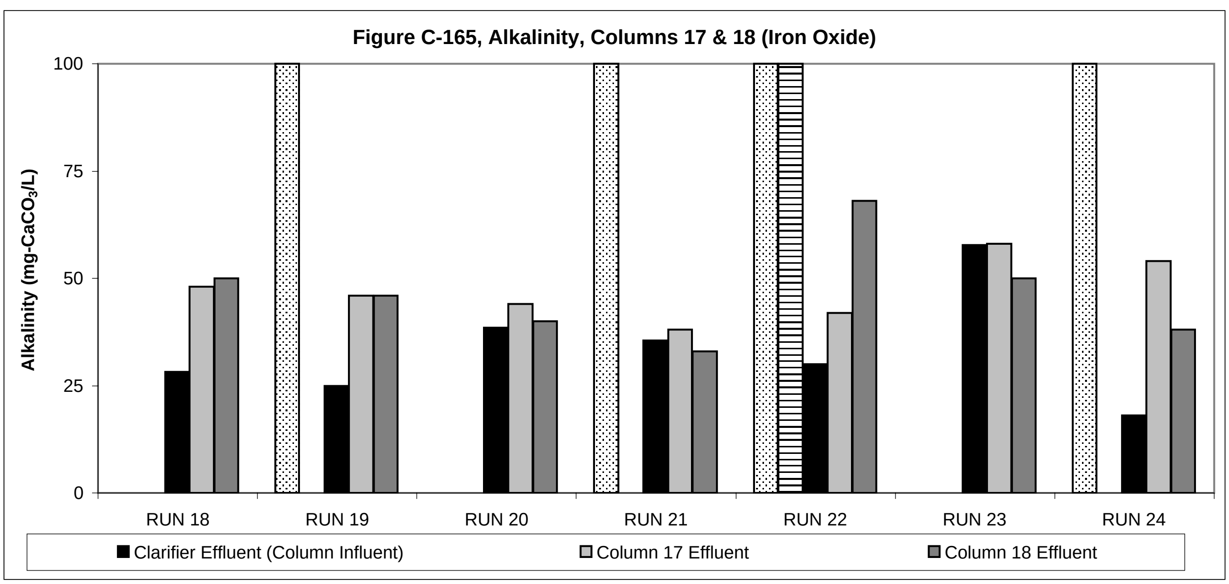


Figure C-165, Alkalinity, Columns 17 & 18 (Iron Oxide)
Alkalinity (mg-CaCO3/L)
100
75
50
25
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 17 Effluent
Column 18 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

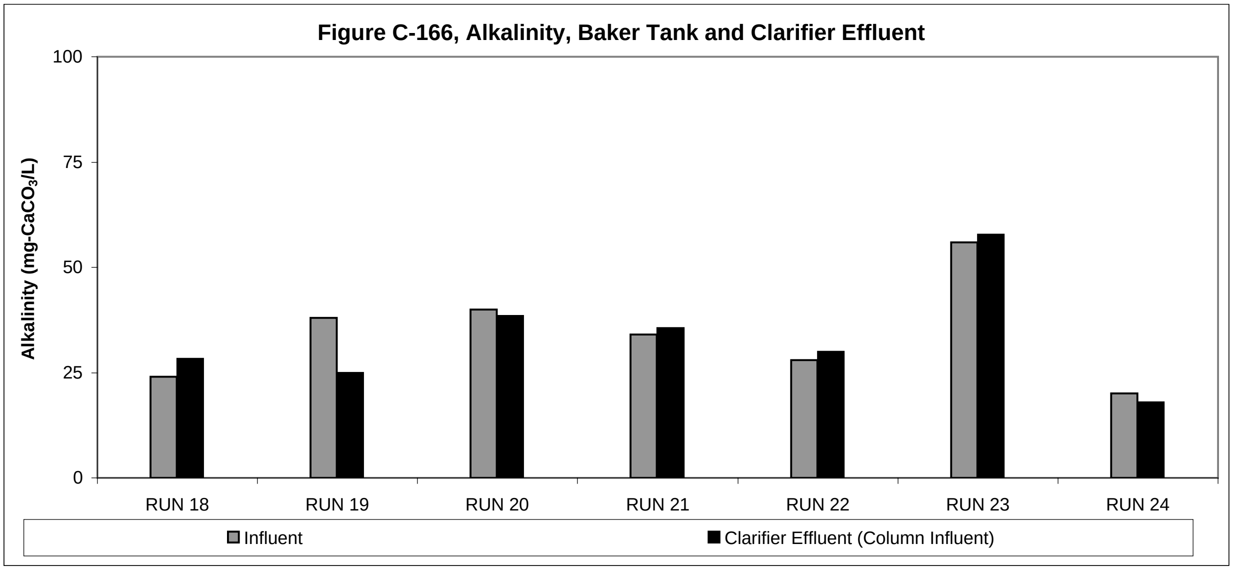


Figure C-166, Alkalinity, Baker Tank and Clarifier Effluent
100
75
50
25
0
Alkalinity (mg-CaCO3/L)
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Influent
Clarifier Effluent (Column Influent)

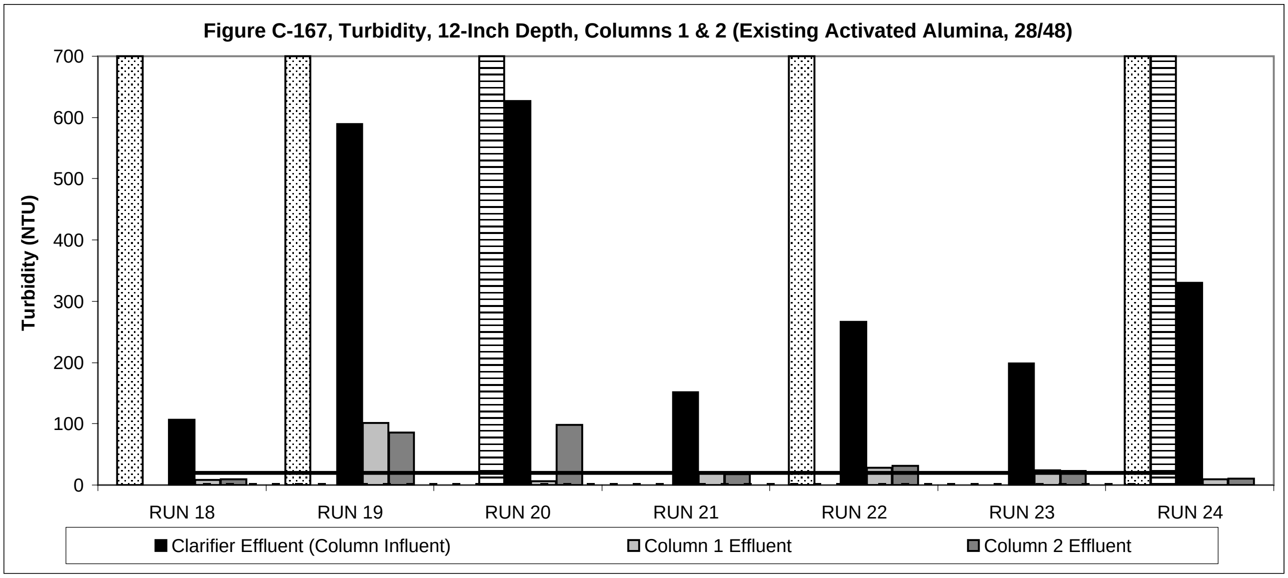


Figure C-167, Turbidity, 12-Inch Depth, Columns 1 & 2 (Existing Activated Alumina, 28/48)
Turbidity (NTU)
700
600
500
400
300
200
100
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 1 Effluent
Column 2 Effluent

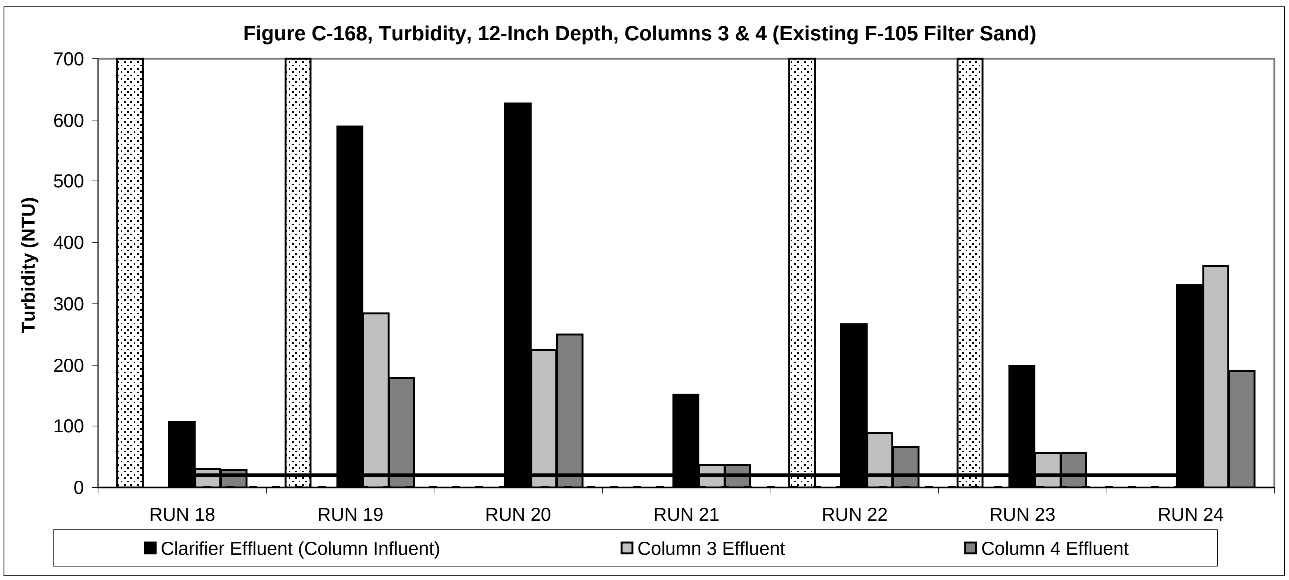


Figure C-168, Turbidity, 12-Inch Depth, Columns 3 & 4 (Existing F-105 Filter Sand)
Turbidity (NTU)
700
600
500
400
300
200
100
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 3 Effluent
Column 4 Effluent

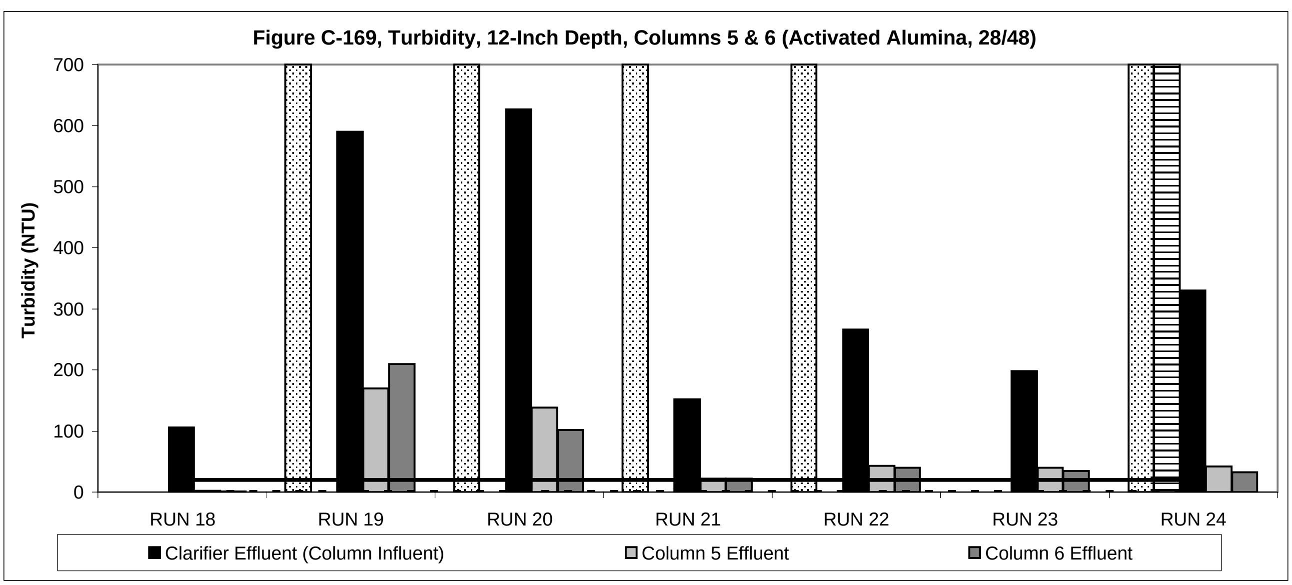


Figure C-169, Turbidity, 12-Inch Depth, Columns 5 & 6 (Activated Alumina, 28/48)
Turbidity (NTU)
700
600
500
400
300
200
100
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 5 Effluent
Column 6 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

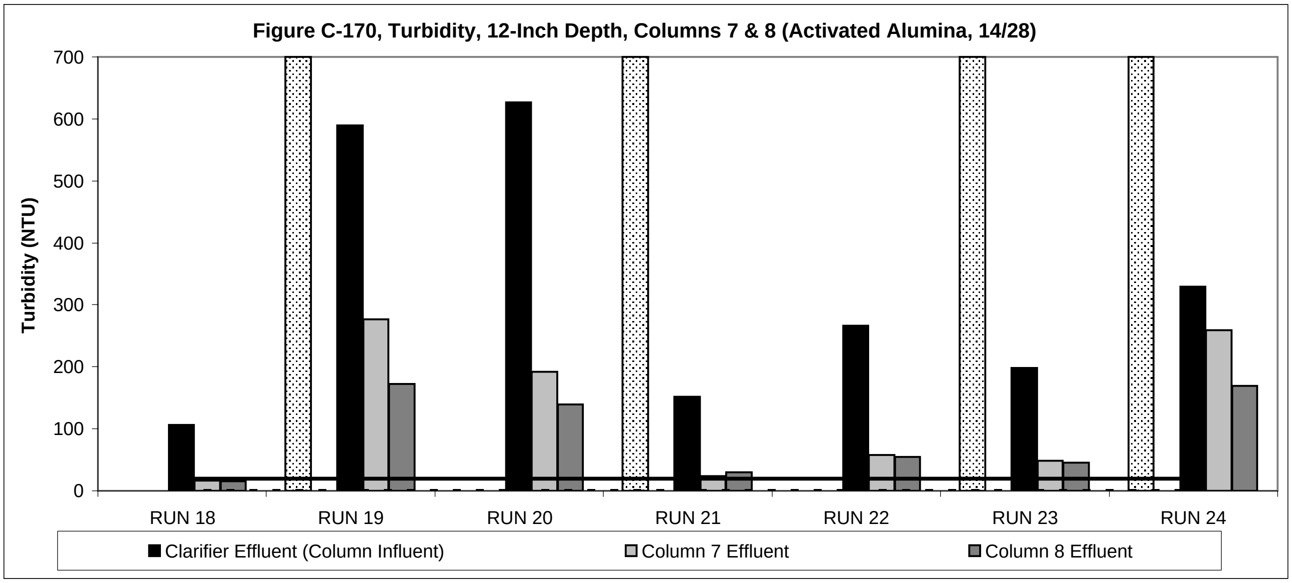


Figure C-170, Turbidity, 12-Inch Depth, Columns 7 & 8 (Activated Alumina, 14/28)
Turbidity (NTU)
0
100
200
300
400
500
600
700
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 7 Effluent
Column 8 Effluent

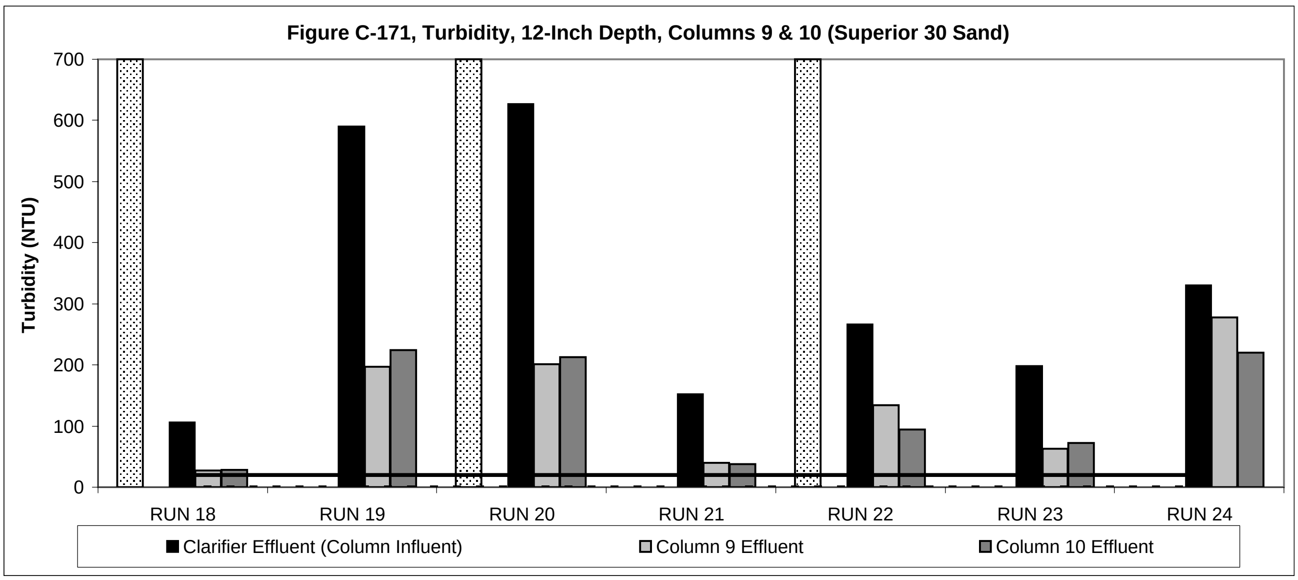


Figure C-171, Turbidity, 12-Inch Depth, Columns 9 & 10 (Superior 30 Sand)
Turbidity (NTU)
0
100
200
300
400
500
600
700
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 9 Effluent
Column 10 Effluent

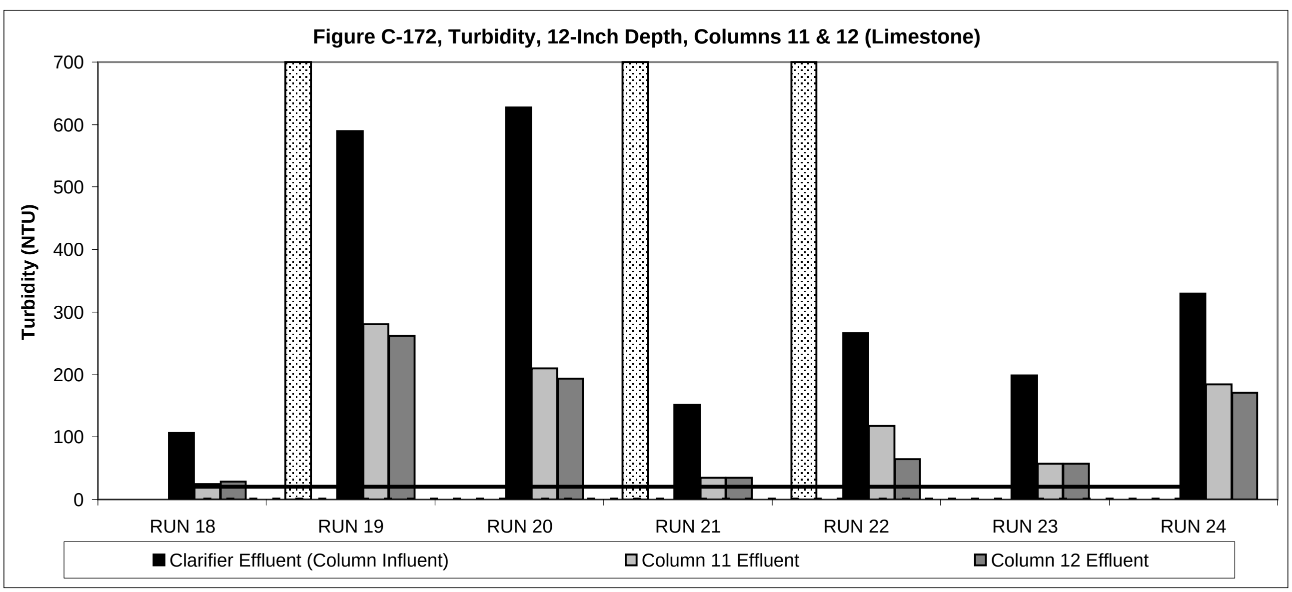


Figure C-172, Turbidity, 12-Inch Depth, Columns 11 & 12 (Limestone)
Turbidity (NTU)
0
100
200
300
400
500
600
700
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 11 Effluent
Column 12 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

Figure C-173, Turbidity, 12-Inch Depth, Columns 13 & 14 (Fe-Modified Activated Alumina)

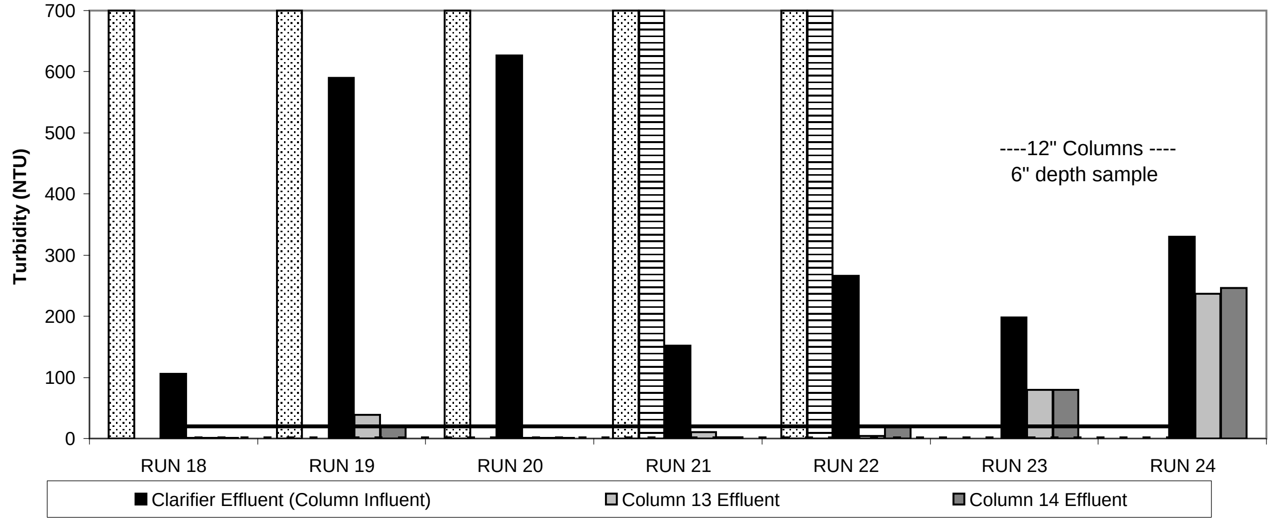


Figure C-174, Turbidity, 12-Inch Depth, Columns 15 & 16 (Granular Ferric Hydroxide)

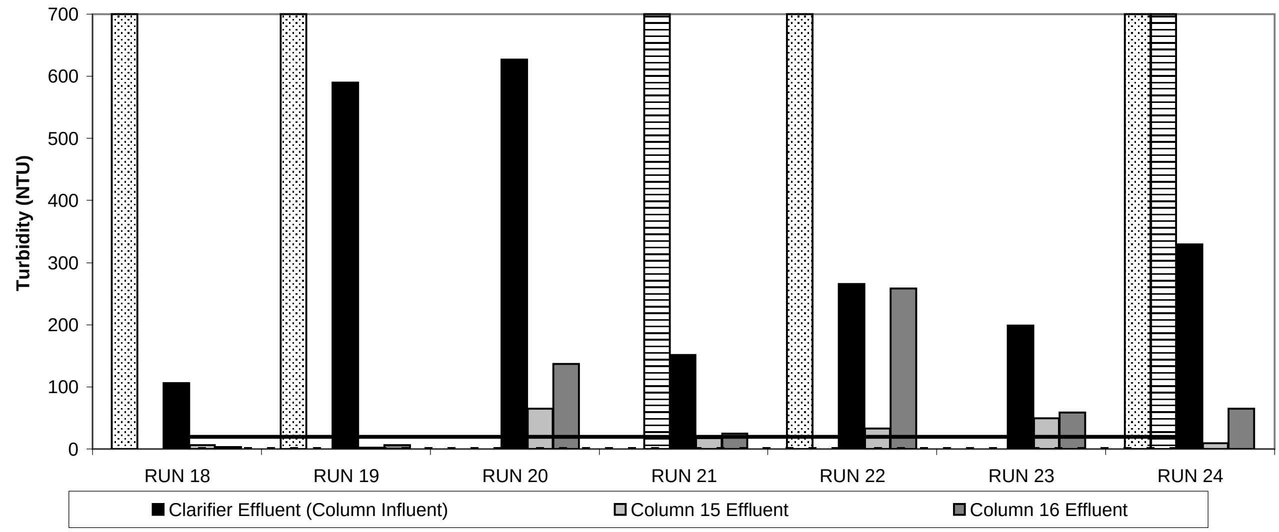
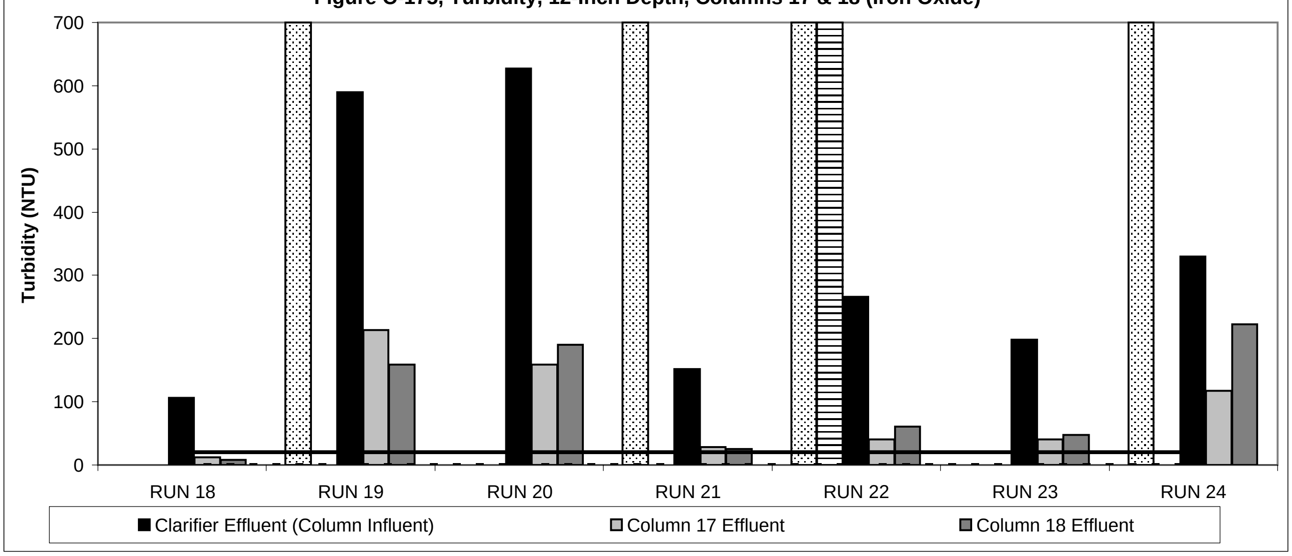
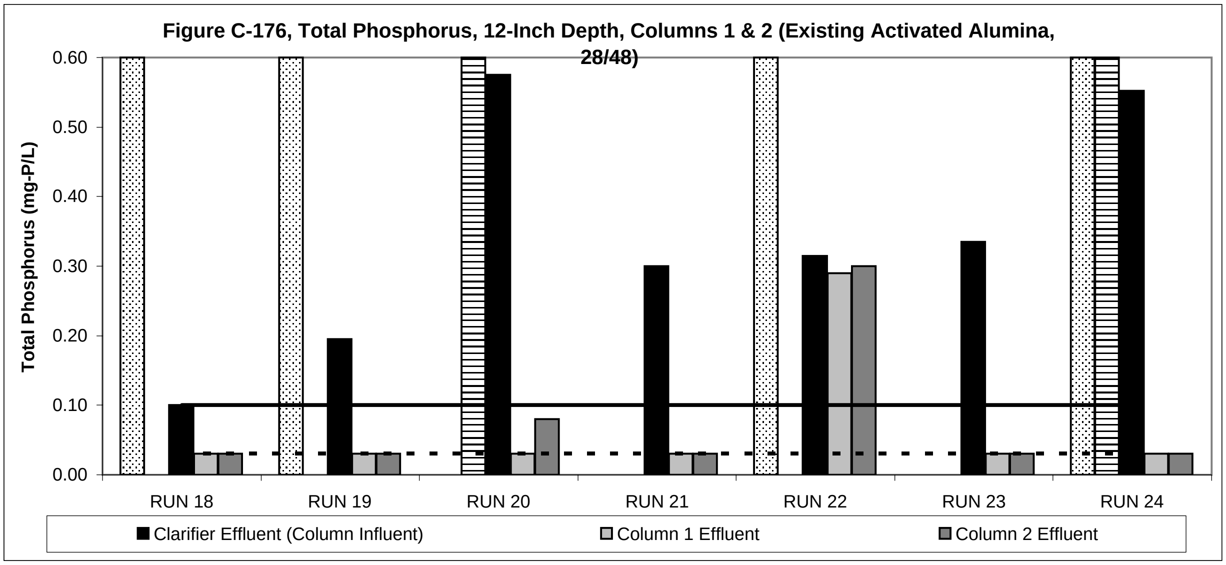
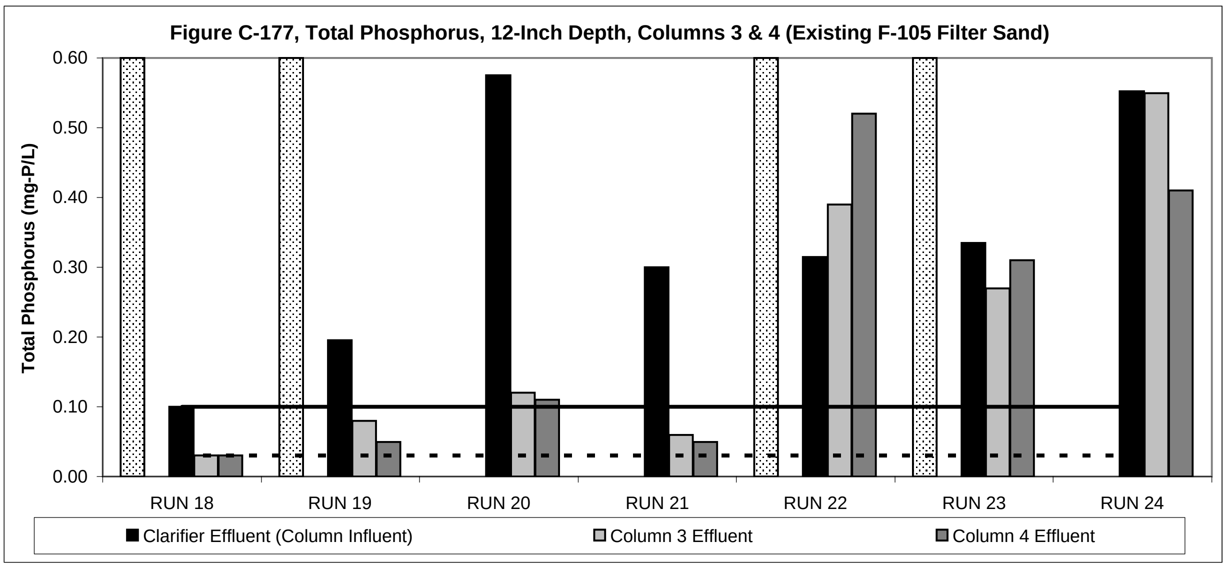
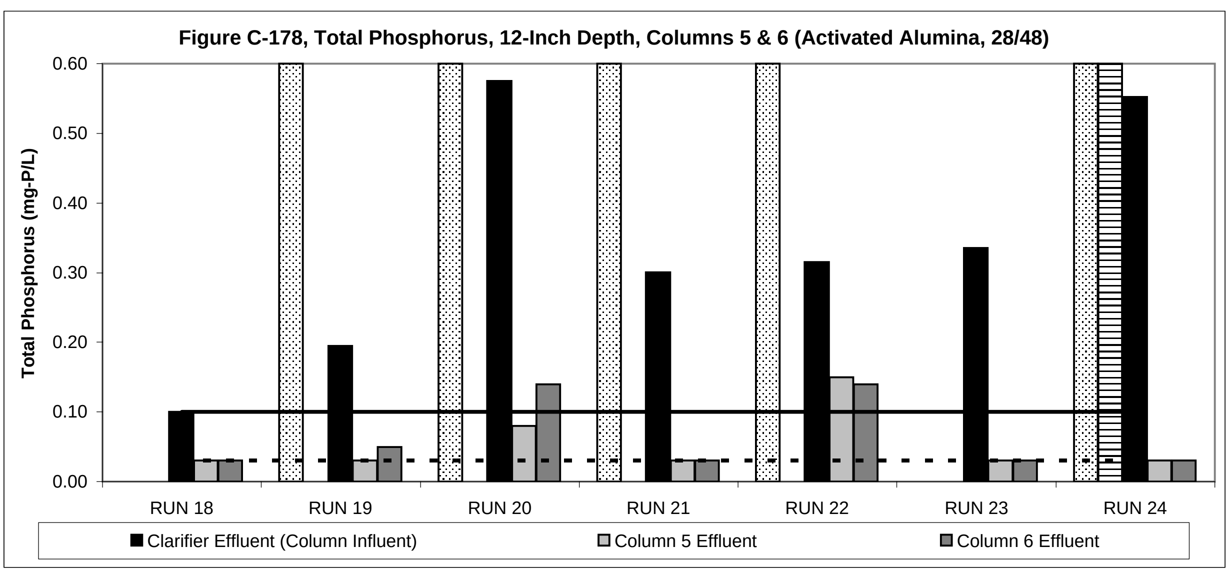


Figure C-175, Turbidity, 12-Inch Depth, Columns 17 & 18 (Iron Oxide)









New Sand Cap   New Media   Reg Lmt   Rpt Lmt

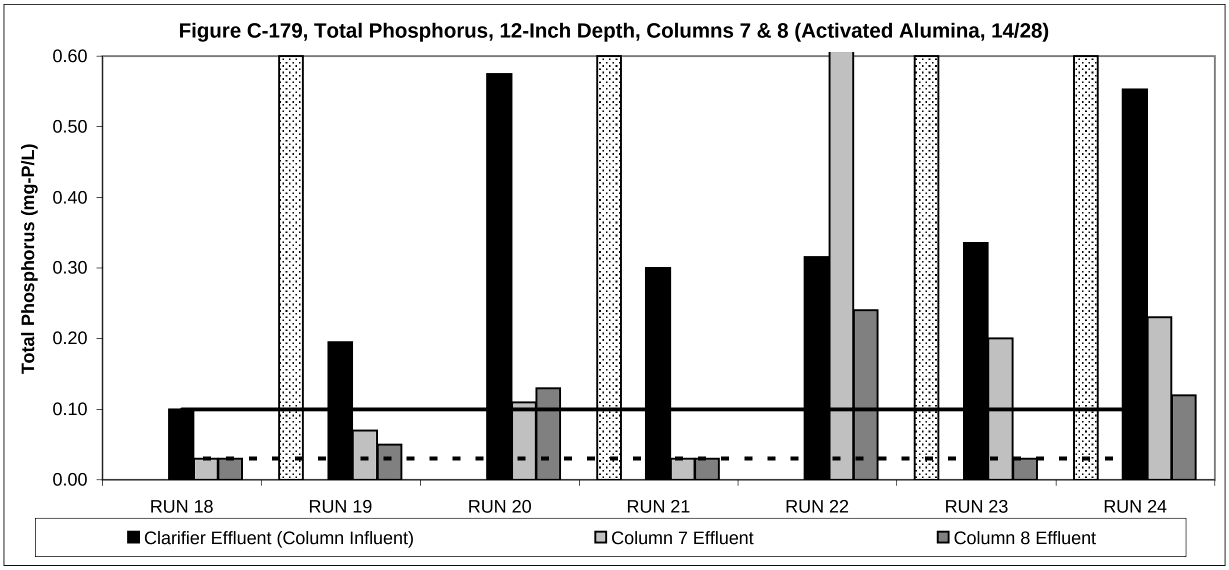


Figure C-179, Total Phosphorus, 12-Inch Depth, Columns 7 & 8 (Activated Alumina, 14/28)
Total Phosphorus (mg-P/L)
0.60
0.50
0.40
0.30
0.20
0.10
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 7 Effluent
Column 8 Effluent

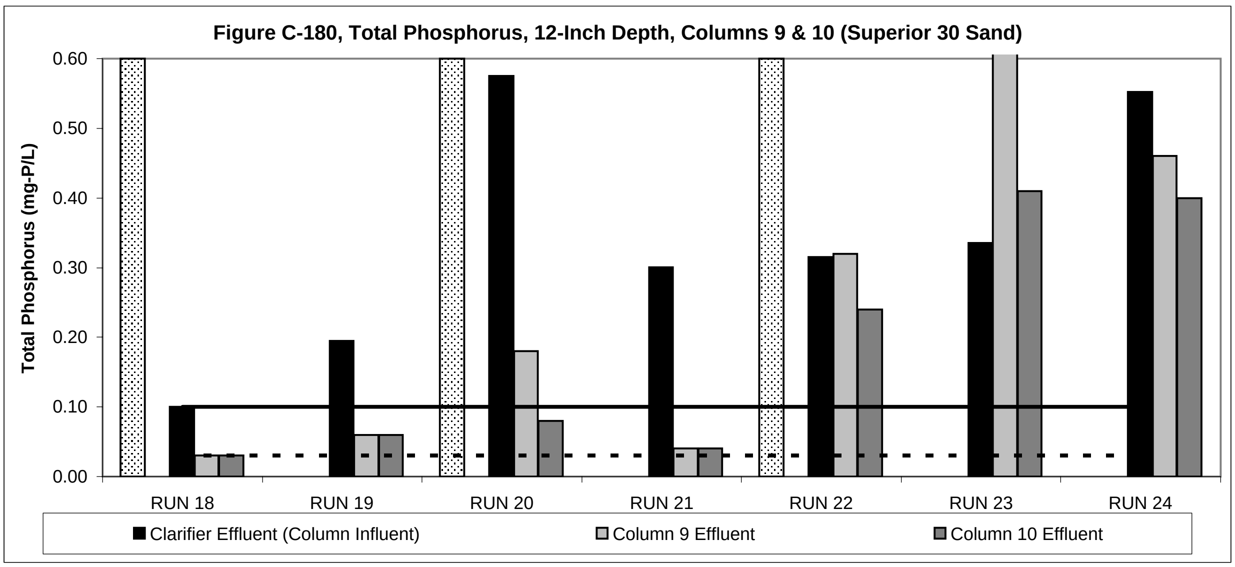


Figure C-180, Total Phosphorus, 12-Inch Depth, Columns 9 & 10 (Superior 30 Sand)
Total Phosphorus (mg-P/L)
0.60
0.50
0.40
0.30
0.20
0.10
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 9 Effluent
Column 10 Effluent

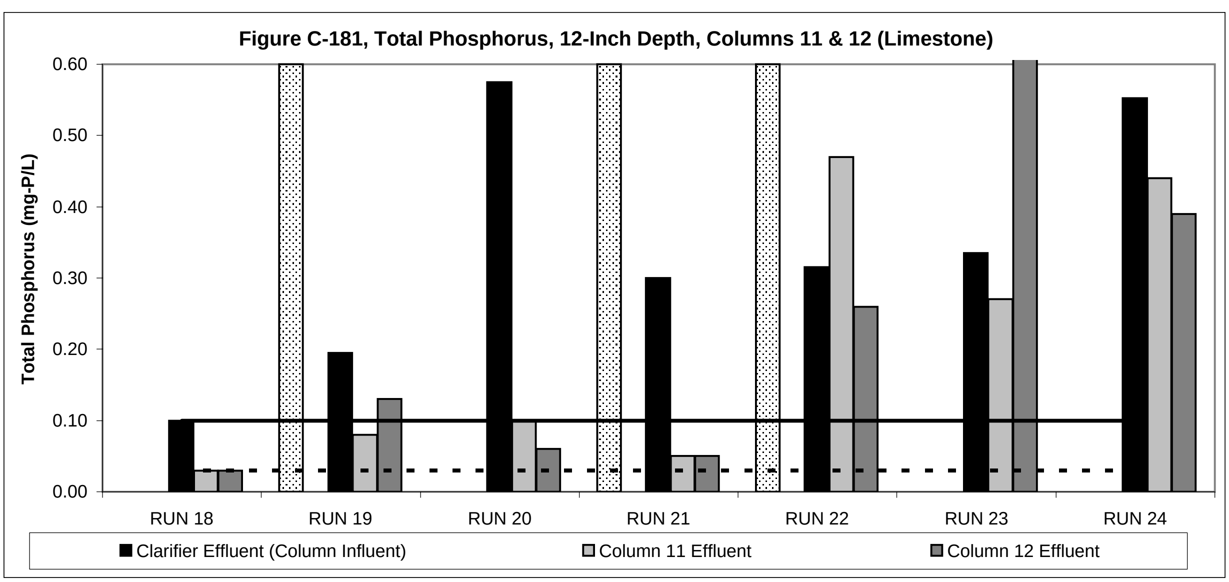


Figure C-181, Total Phosphorus, 12-Inch Depth, Columns 11 & 12 (Limestone)
Total Phosphorus (mg-P/L)
0.60
0.50
0.40
0.30
0.20
0.10
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 11 Effluent
Column 12 Effluent

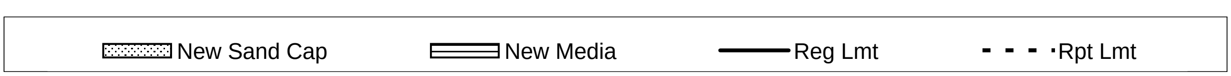

New Sand Cap
New Media
Reg Lmt
Rpt Lmt

Figure C-182, Total Phosphorus, 12-Inch Depth, Columns 13 & 14 (Fe-Modified Activated Alumina)

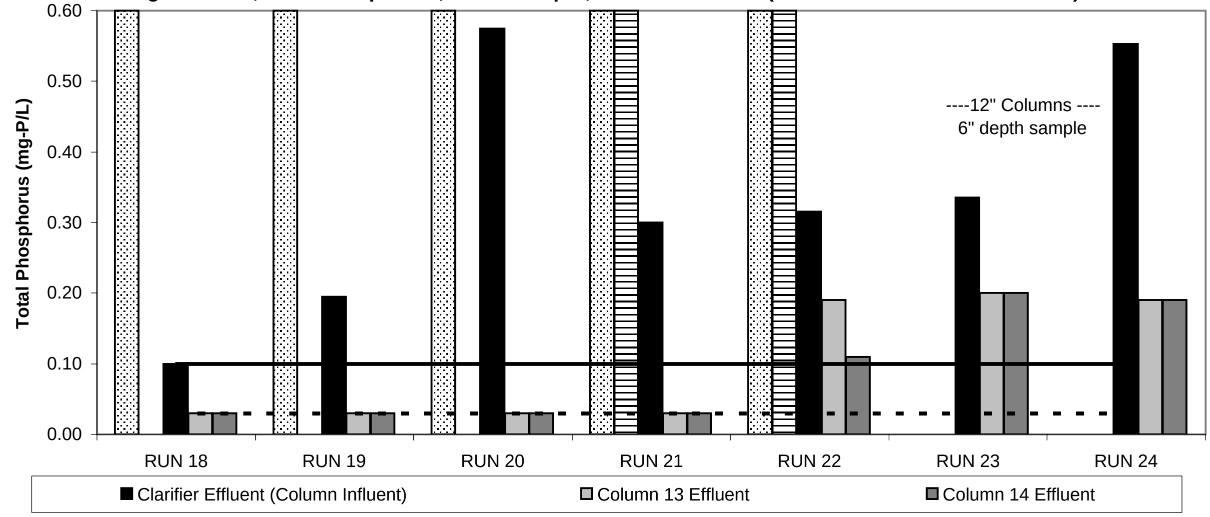


Figure C-183, Total Phosphorus, 12-Inch Depth, Columns 15 & 16 (Granular Ferric Hydroxide)

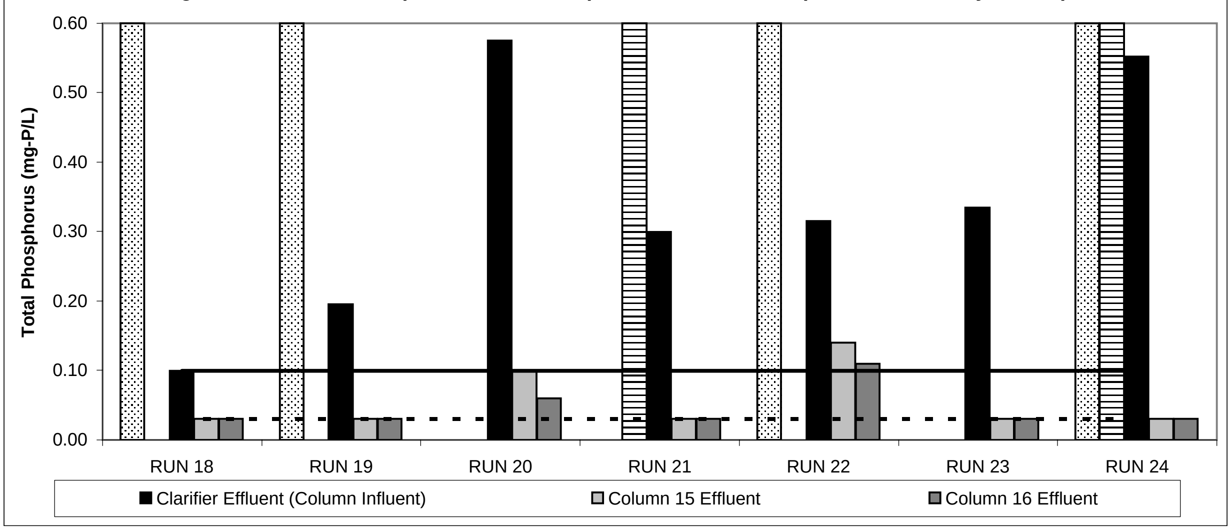
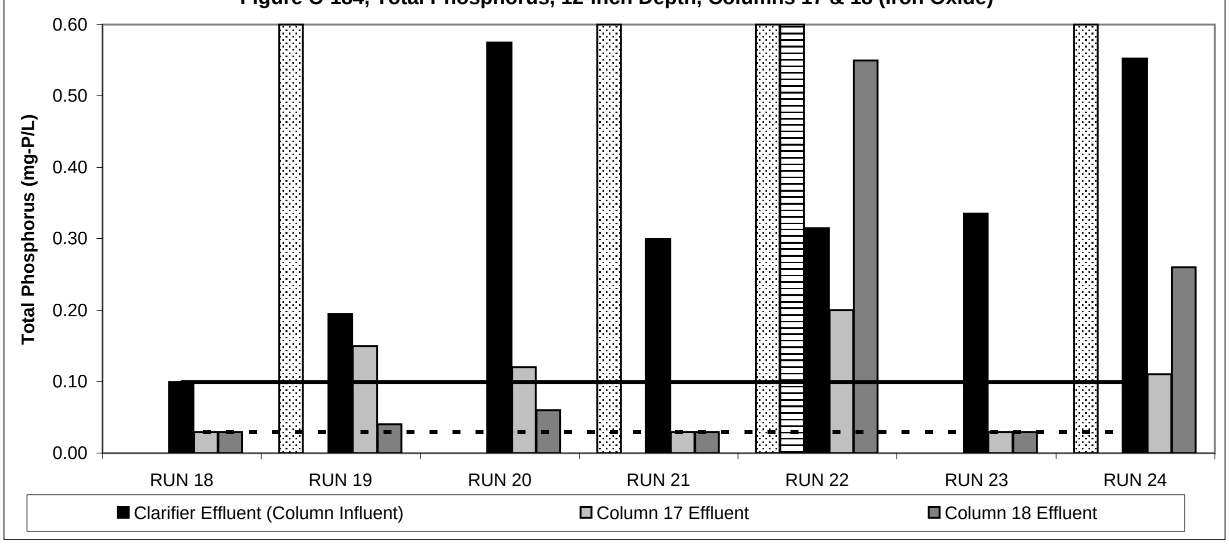


Figure C-184, Total Phosphorus, 12-Inch Depth, Columns 17 & 18 (Iron Oxide)



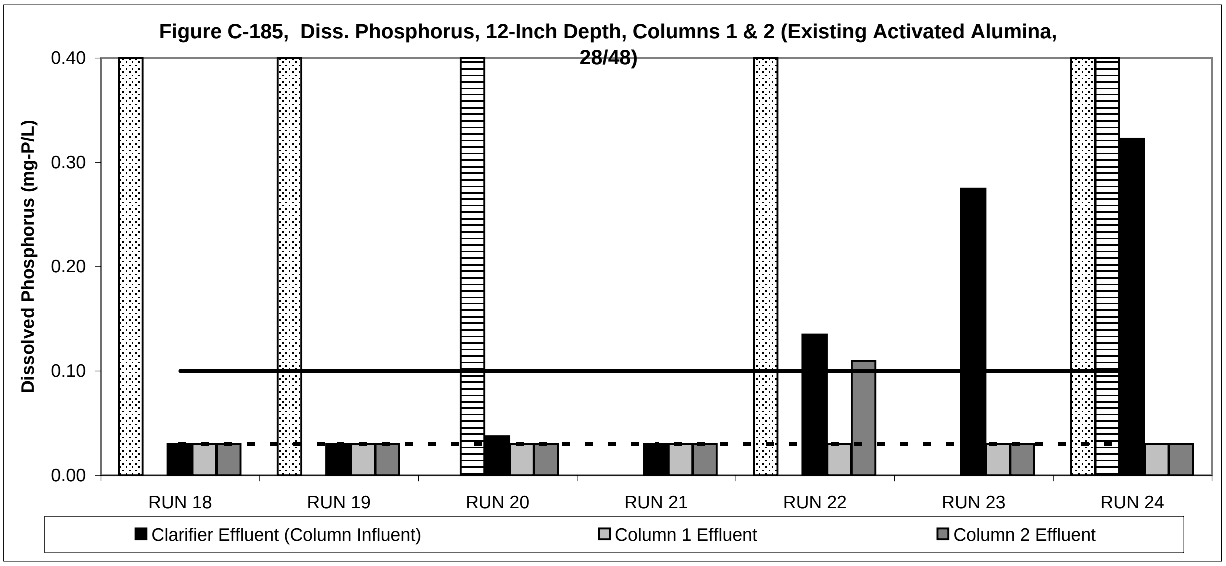


Figure C-185, Diss. Phosphorus, 12-Inch Depth, Columns 1 & 2 (Existing Activated Alumina, 28/48)
Dissolved Phosphorus (mg-P/L)
0.00
0.10
0.20
0.30
0.40
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 1 Effluent
Column 2 Effluent

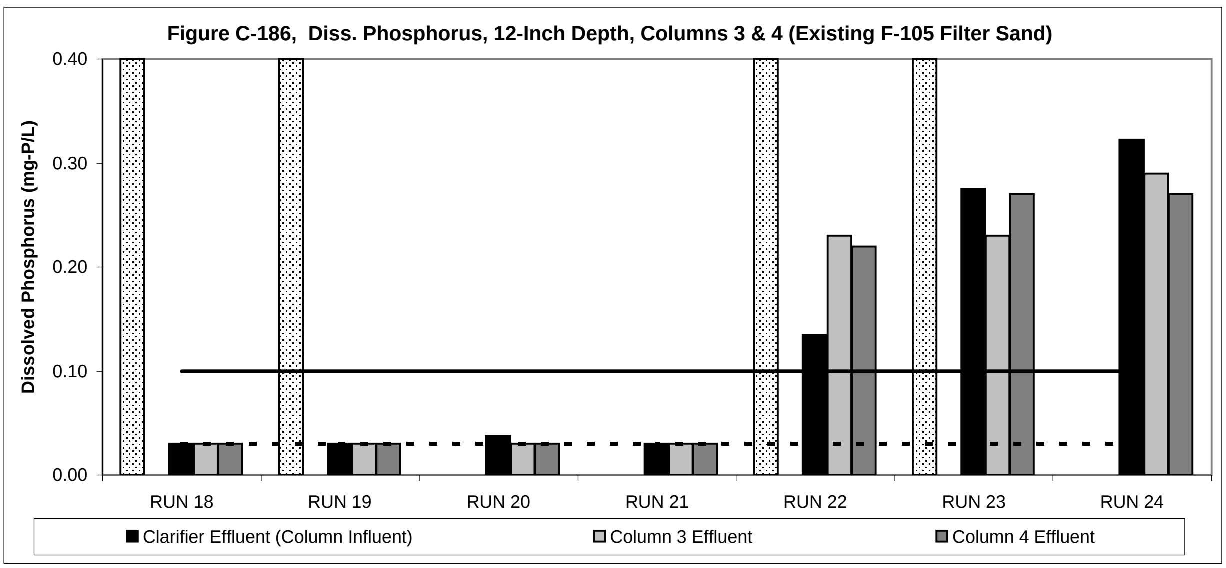


Figure C-186, Diss. Phosphorus, 12-Inch Depth, Columns 3 & 4 (Existing F-105 Filter Sand)
Dissolved Phosphorus (mg-P/L)
0.00
0.10
0.20
0.30
0.40
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 3 Effluent
Column 4 Effluent

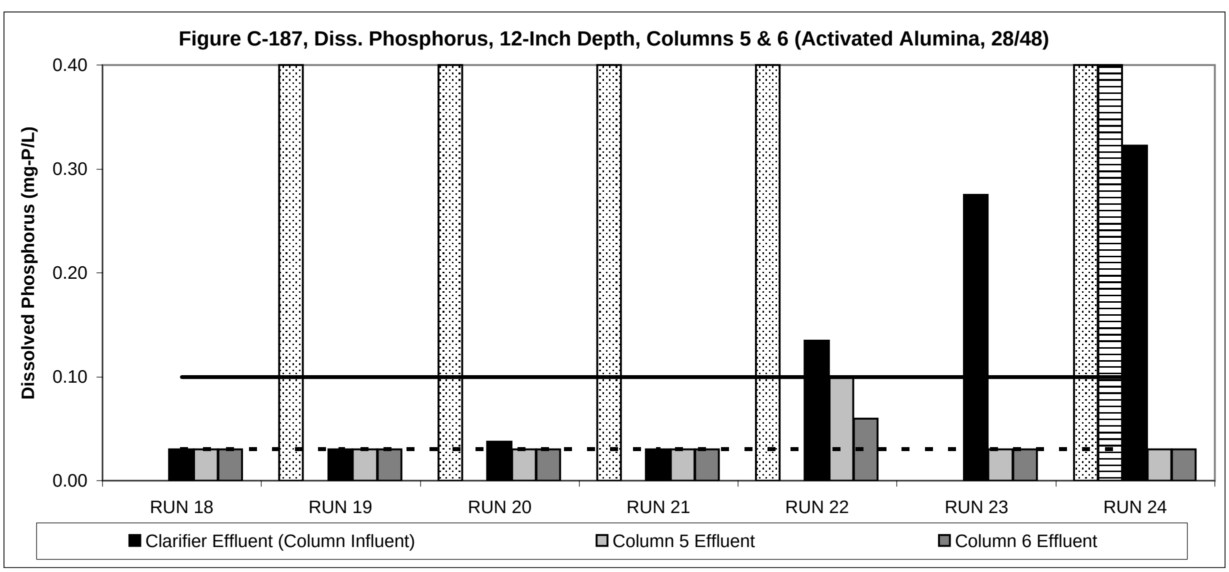


Figure C-187, Diss. Phosphorus, 12-Inch Depth, Columns 5 & 6 (Activated Alumina, 28/48)
Dissolved Phosphorus (mg-P/L)
0.00
0.10
0.20
0.30
0.40
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 5 Effluent
Column 6 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

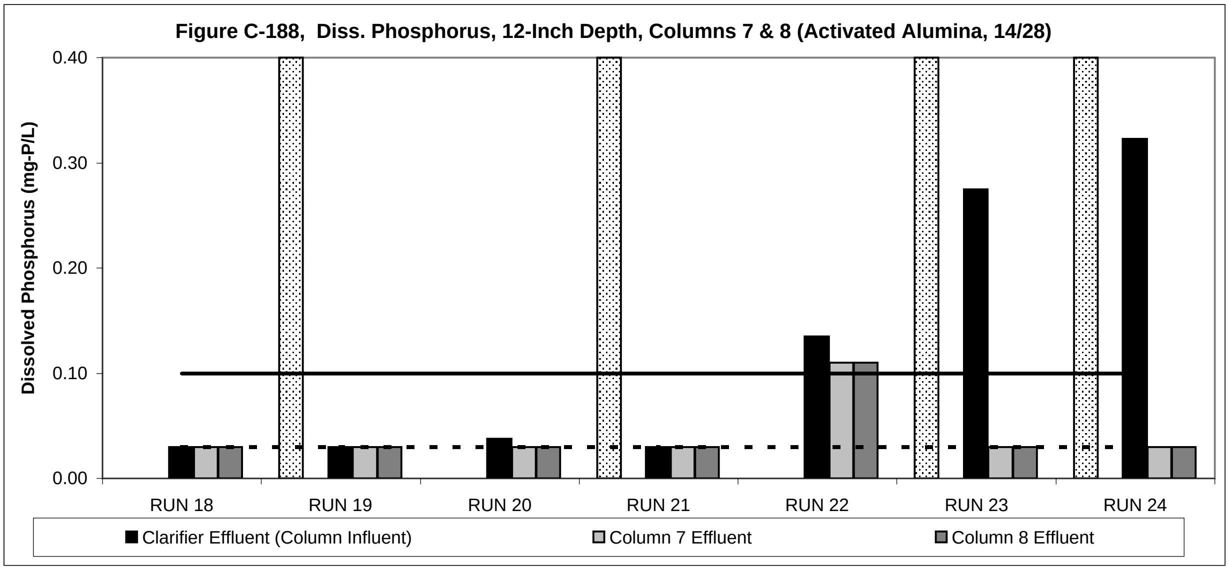


Figure C-188, Diss. Phosphorus, 12-Inch Depth, Columns 7 & 8 (Activated Alumina, 14/28)
Dissolved Phosphorus (mg-P/L)
0.40
0.30
0.20
0.10
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 7 Effluent
Column 8 Effluent

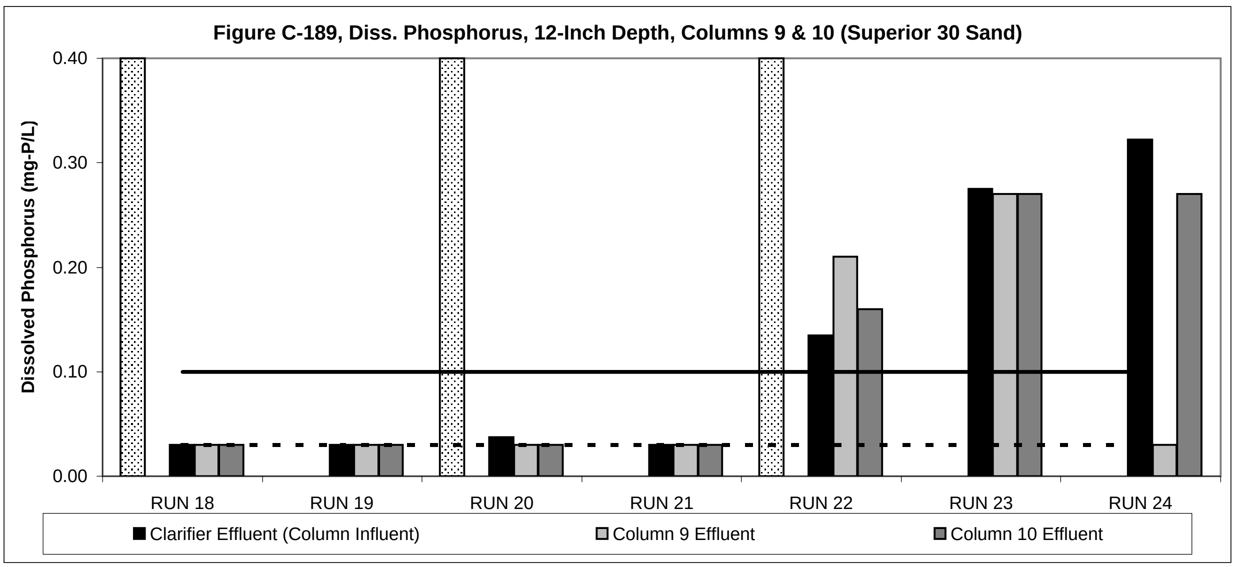


Figure C-189, Diss. Phosphorus, 12-Inch Depth, Columns 9 & 10 (Superior 30 Sand)
Dissolved Phosphorus (mg-P/L)
0.40
0.30
0.20
0.10
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 9 Effluent
Column 10 Effluent

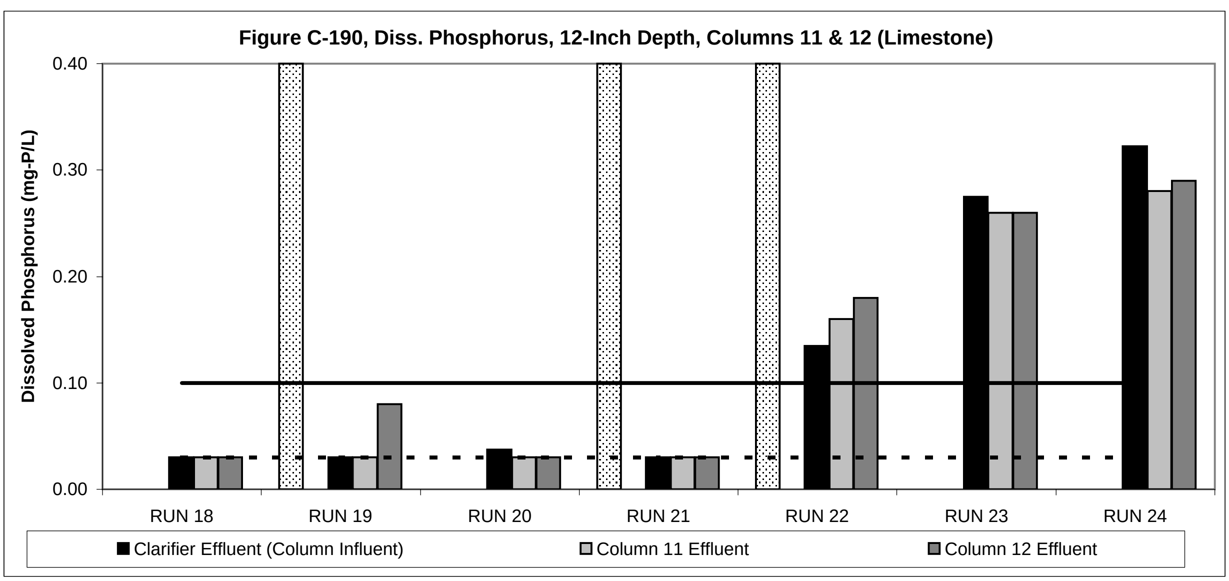


Figure C-190, Diss. Phosphorus, 12-Inch Depth, Columns 11 & 12 (Limestone)
Dissolved Phosphorus (mg-P/L)
0.40
0.30
0.20
0.10
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 11 Effluent
Column 12 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

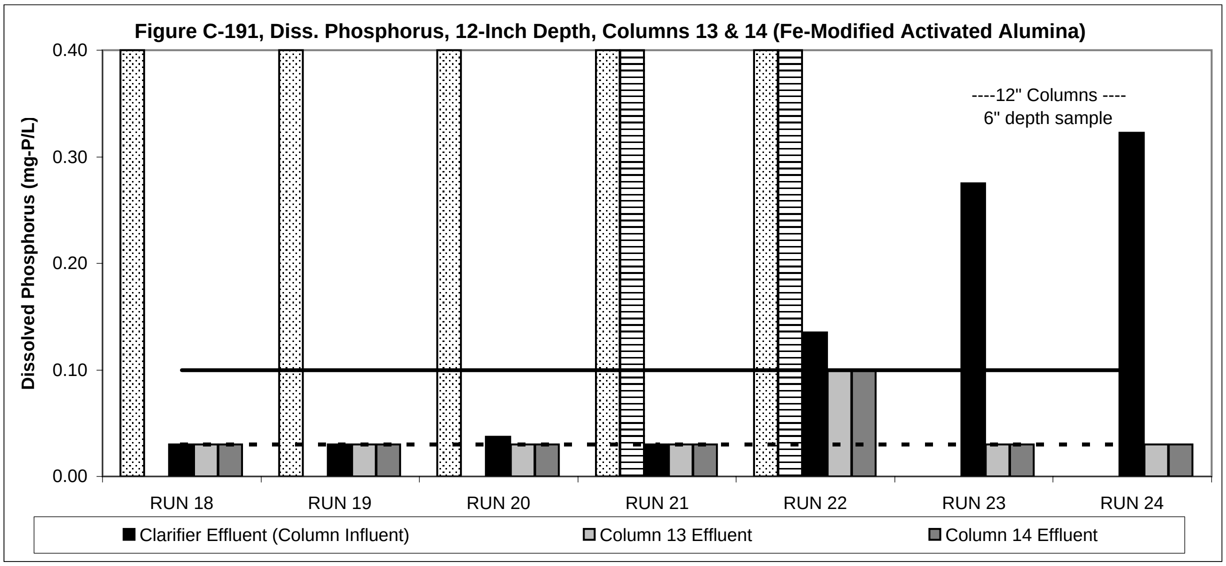


Figure C-191, Diss. Phosphorus, 12-Inch Depth, Columns 13 & 14 (Fe-Modified Activated Alumina)
Dissolved Phosphorus (mg-P/L)
0.40
0.30
0.20
0.10
0.00
----12" Columns ----
6" depth sample
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 13 Effluent
Column 14 Effluent

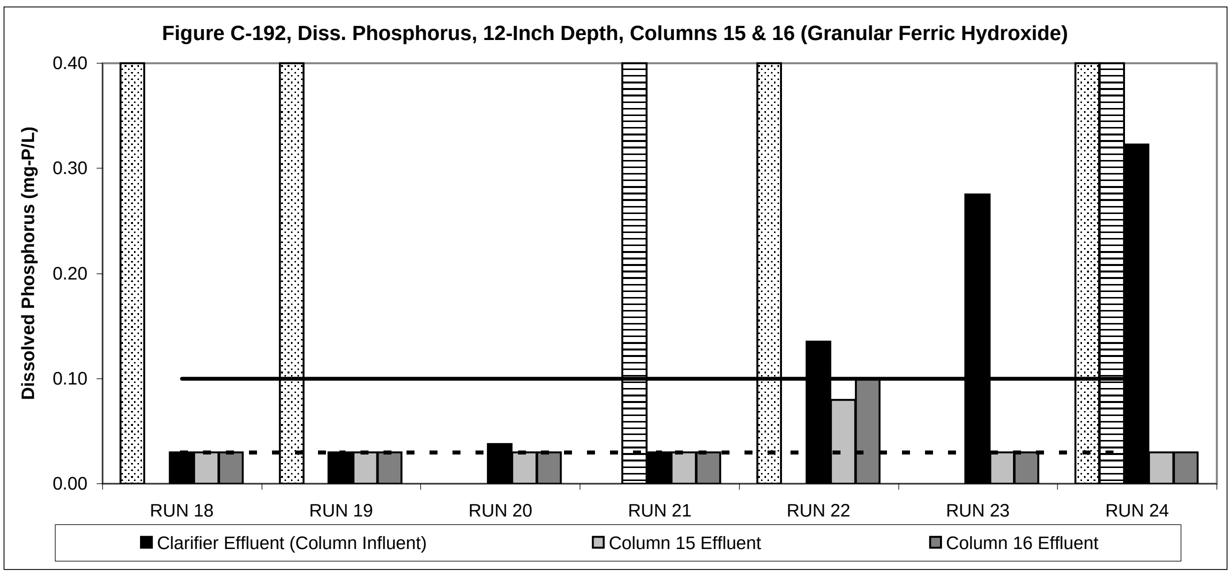


Figure C-192, Diss. Phosphorus, 12-Inch Depth, Columns 15 & 16 (Granular Ferric Hydroxide)
Dissolved Phosphorus (mg-P/L)
0.40
0.30
0.20
0.10
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 15 Effluent
Column 16 Effluent

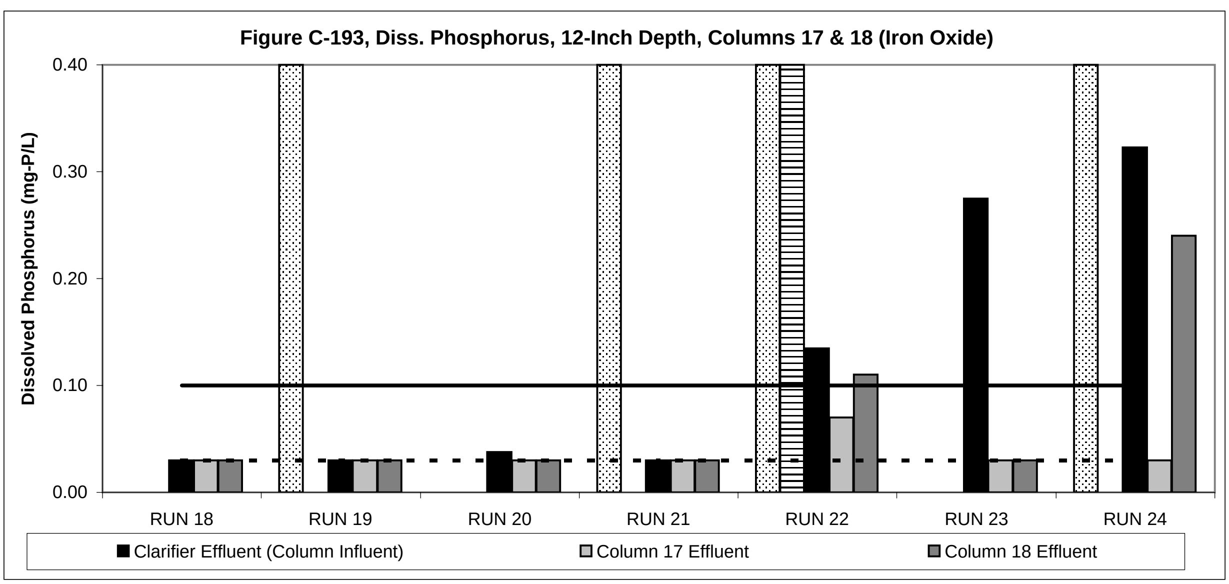


Figure C-193, Diss. Phosphorus, 12-Inch Depth, Columns 17 & 18 (Iron Oxide)
Dissolved Phosphorus (mg-P/L)
0.40
0.30
0.20
0.10
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Column 17 Effluent
Column 18 Effluent


New Sand Cap
New Media
Reg Lmt
Rpt Lmt

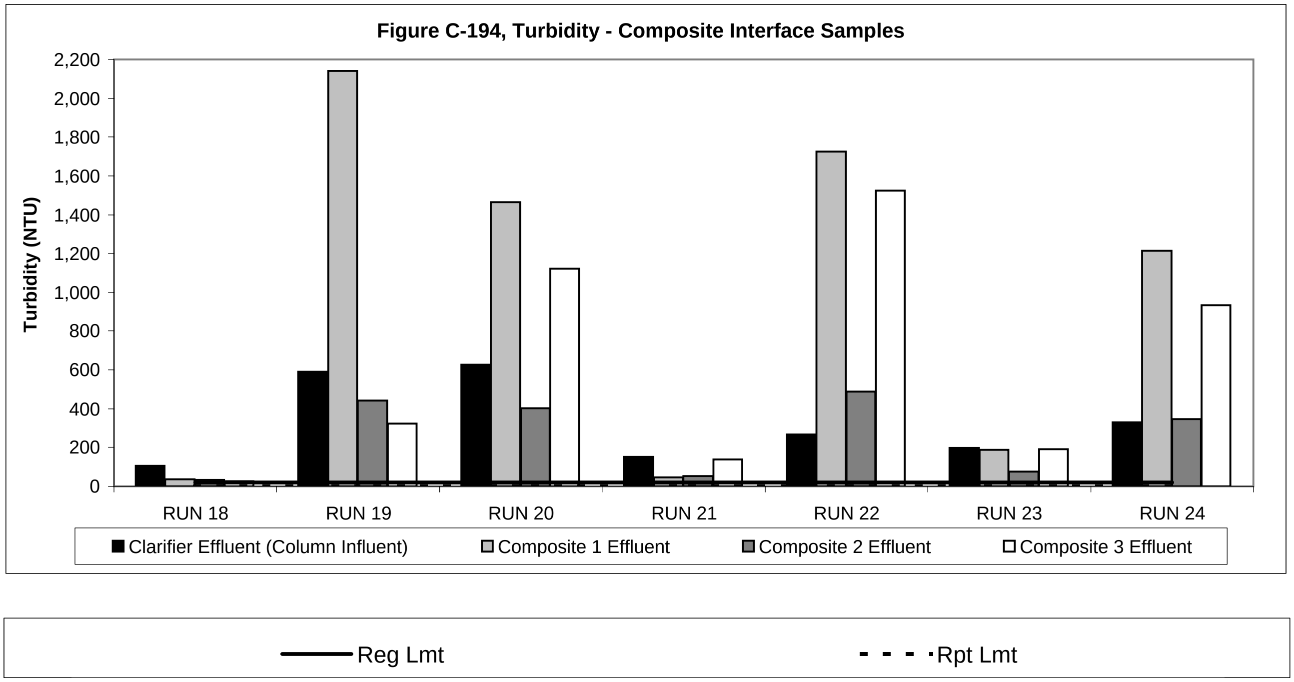


Figure C-194, Turbidity - Composite Interface Samples
Turbidity (NTU)
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Composite 1 Effluent
Composite 2 Effluent
Composite 3 Effluent
Reg Lmt
Rpt Lmt

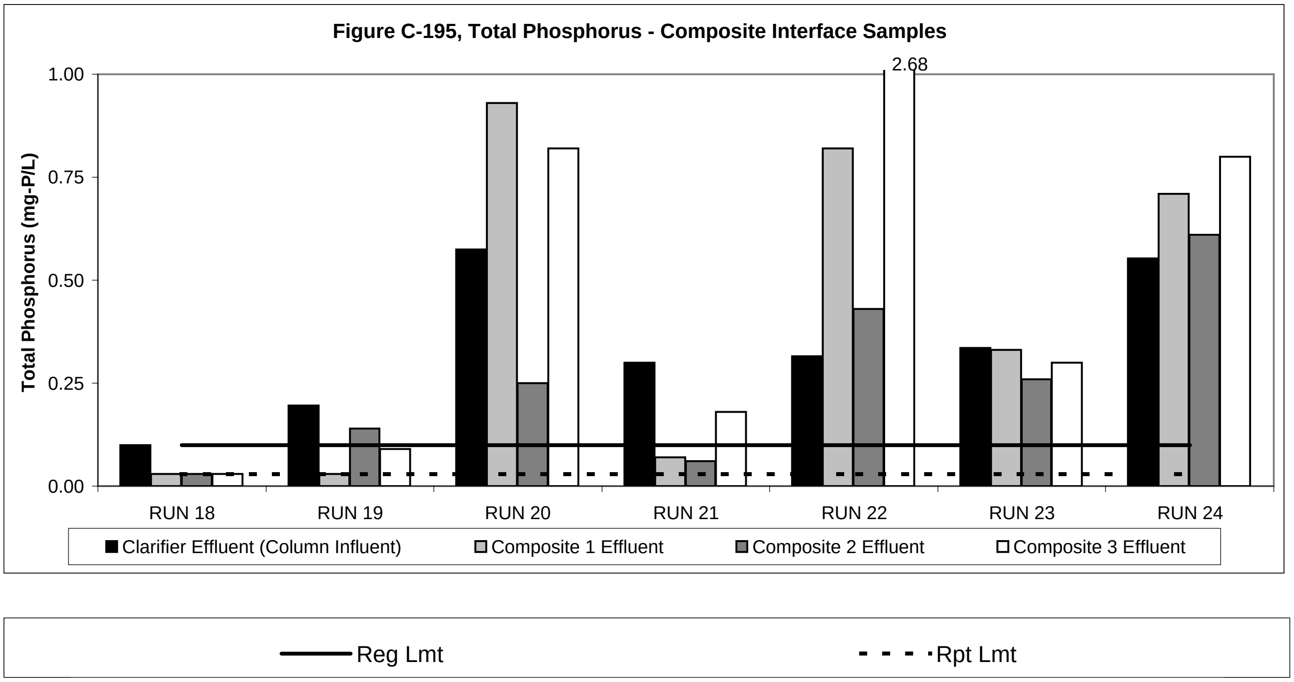


Figure C-195, Total Phosphorus - Composite Interface Samples
Total Phosphorus (mg-P/L)
1.00
0.75
0.50
0.25
0.00
2.68
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Composite 1 Effluent
Composite 2 Effluent
Composite 3 Effluent
Reg Lmt
Rpt Lmt

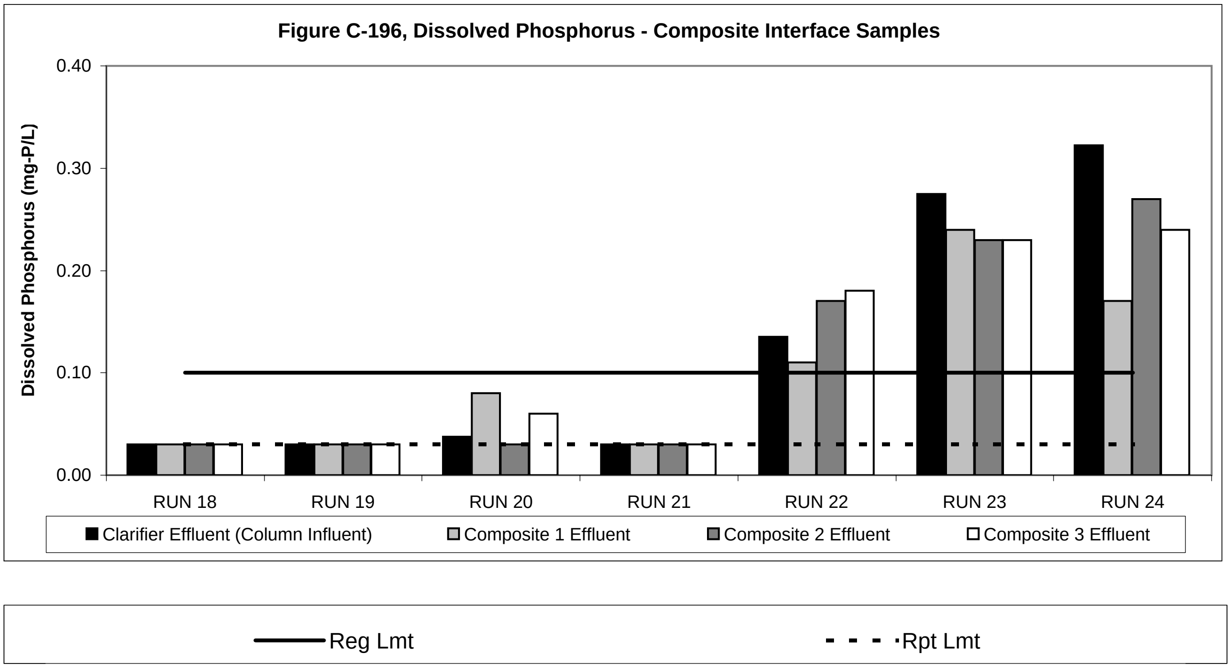


Figure C-196, Dissolved Phosphorus - Composite Interface Samples
Dissolved Phosphorus (mg-P/L)
0.40
0.30
0.20
0.10
0.00
RUN 18
RUN 19
RUN 20
RUN 21
RUN 22
RUN 23
RUN 24
Clarifier Effluent (Column Influent)
Composite 1 Effluent
Composite 2 Effluent
Composite 3 Effluent
Reg Lmt
Rpt Lmt

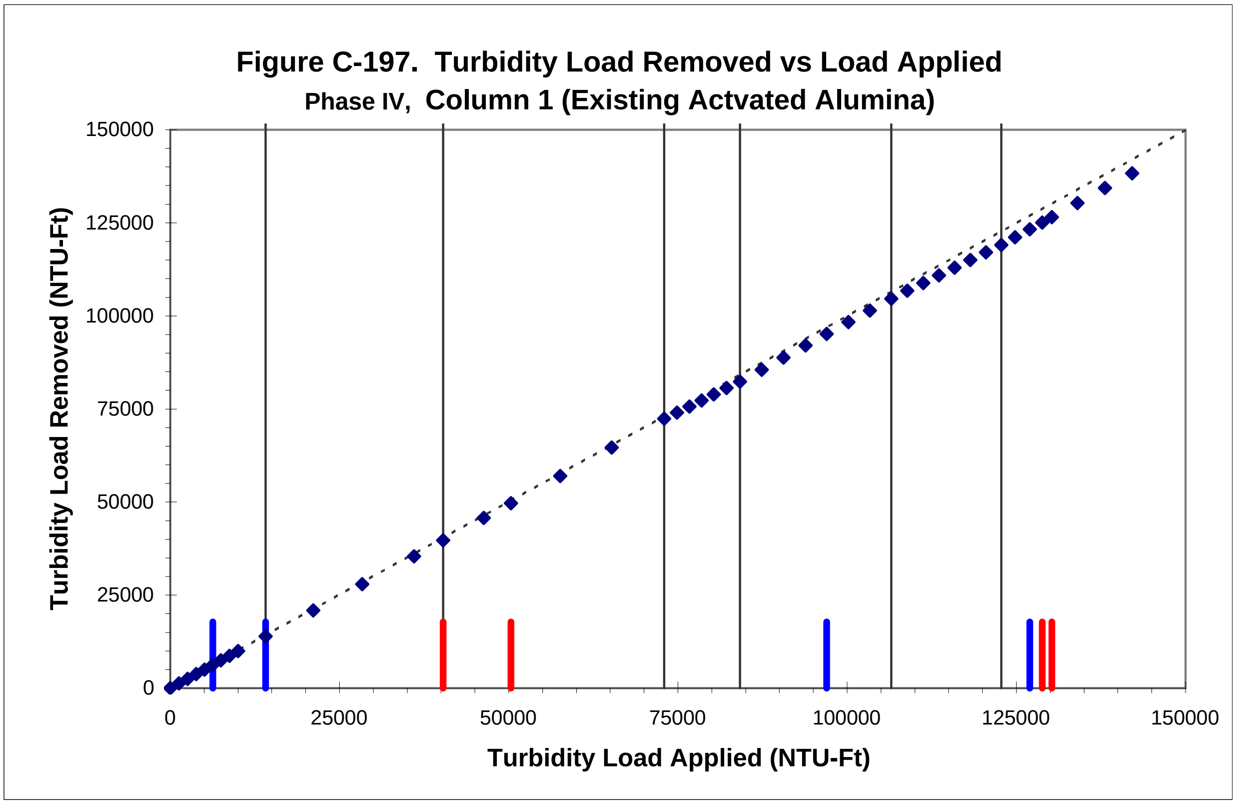


Figure C-197. Turbidity Load Removed vs Load Applied
Phase IV, Column 1 (Existing Actvated Alumina)
Turbidity Load Removed (NTU-Ft)
Turbidity Load Applied (NTU-Ft)
0
25000
50000
75000
100000
125000
150000

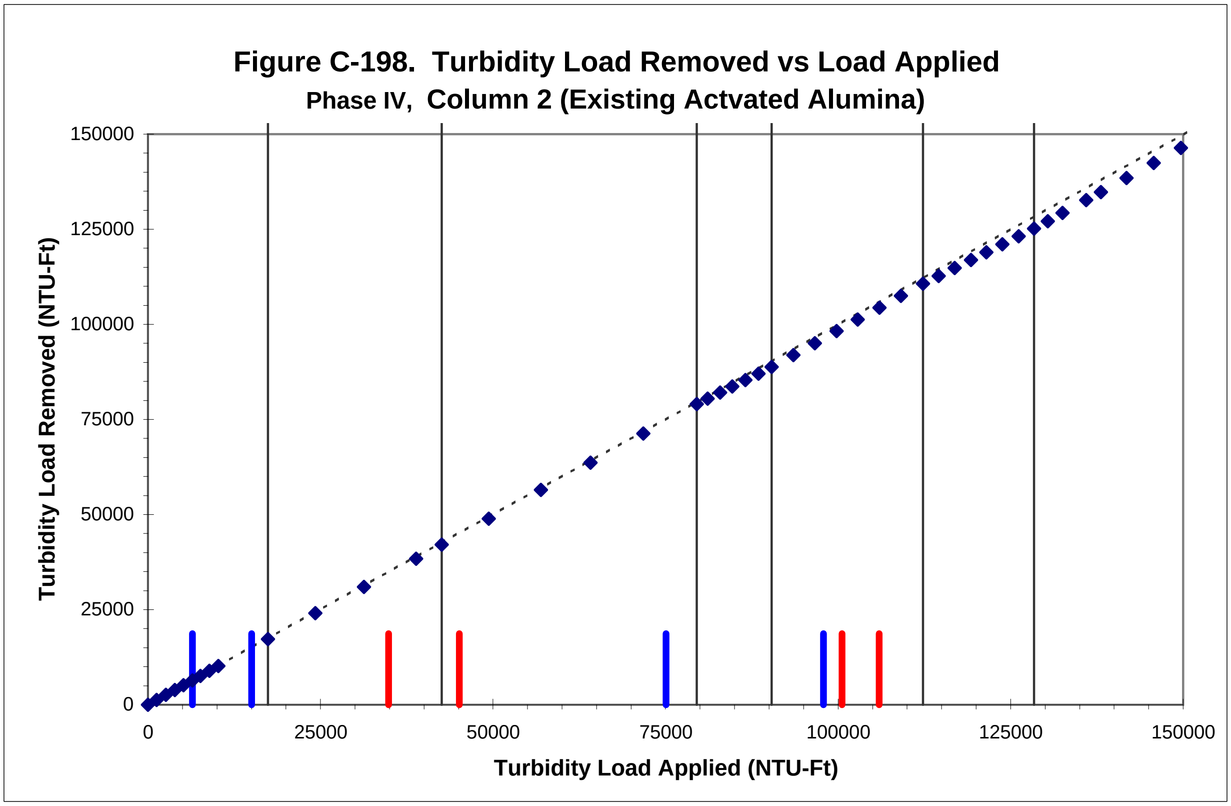
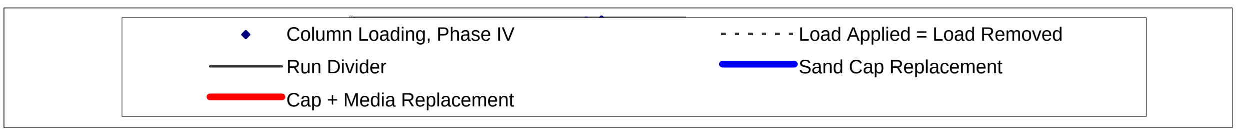


Figure C-198. Turbidity Load Removed vs Load Applied
Phase IV, Column 2 (Existing Actvated Alumina)
Turbidity Load Removed (NTU-Ft)
Turbidity Load Applied (NTU-Ft)
0
25000
50000
75000
100000
125000
150000


Column Loading, Phase IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

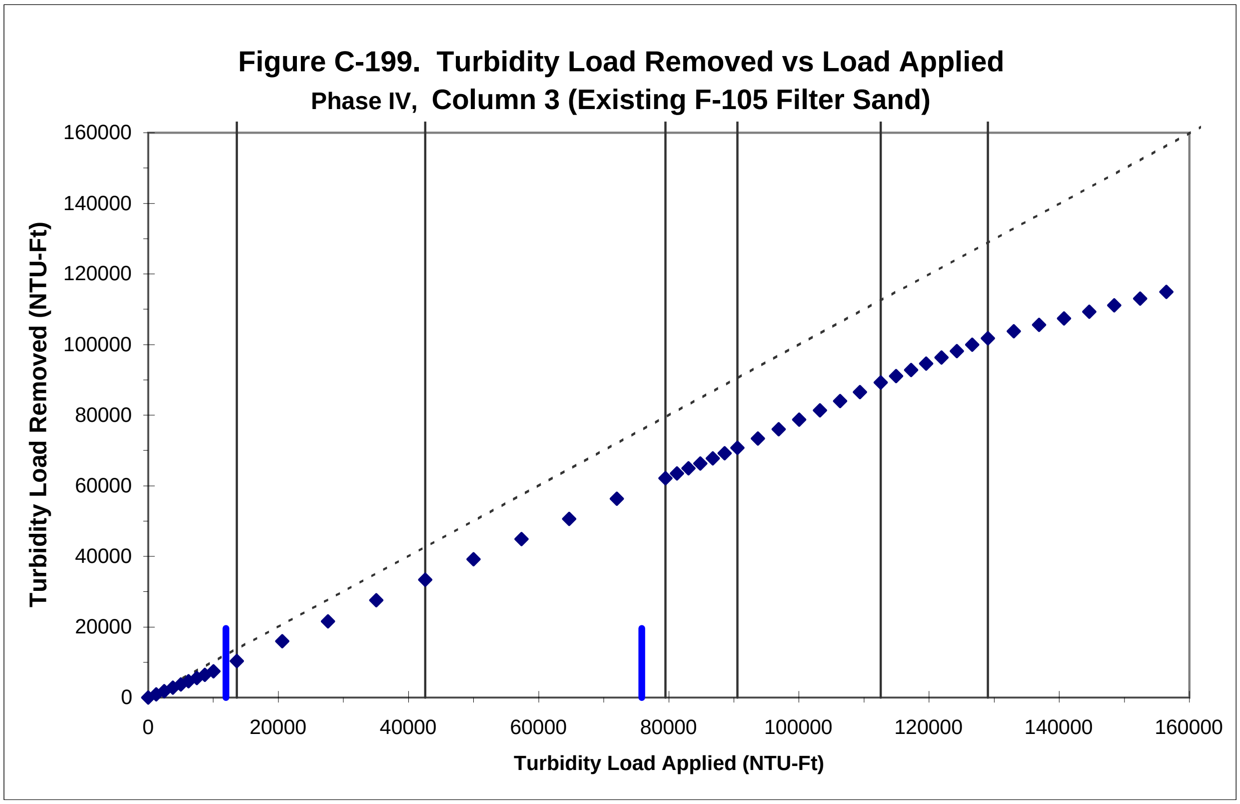


Figure C-199. Turbidity Load Removed vs Load Applied
Phase IV, Column 3 (Existing F-105 Filter Sand)
Turbidity Load Removed (NTU-Ft)
Turbidity Load Applied (NTU-Ft)
0
20000
40000
60000
80000
100000
120000
140000
160000

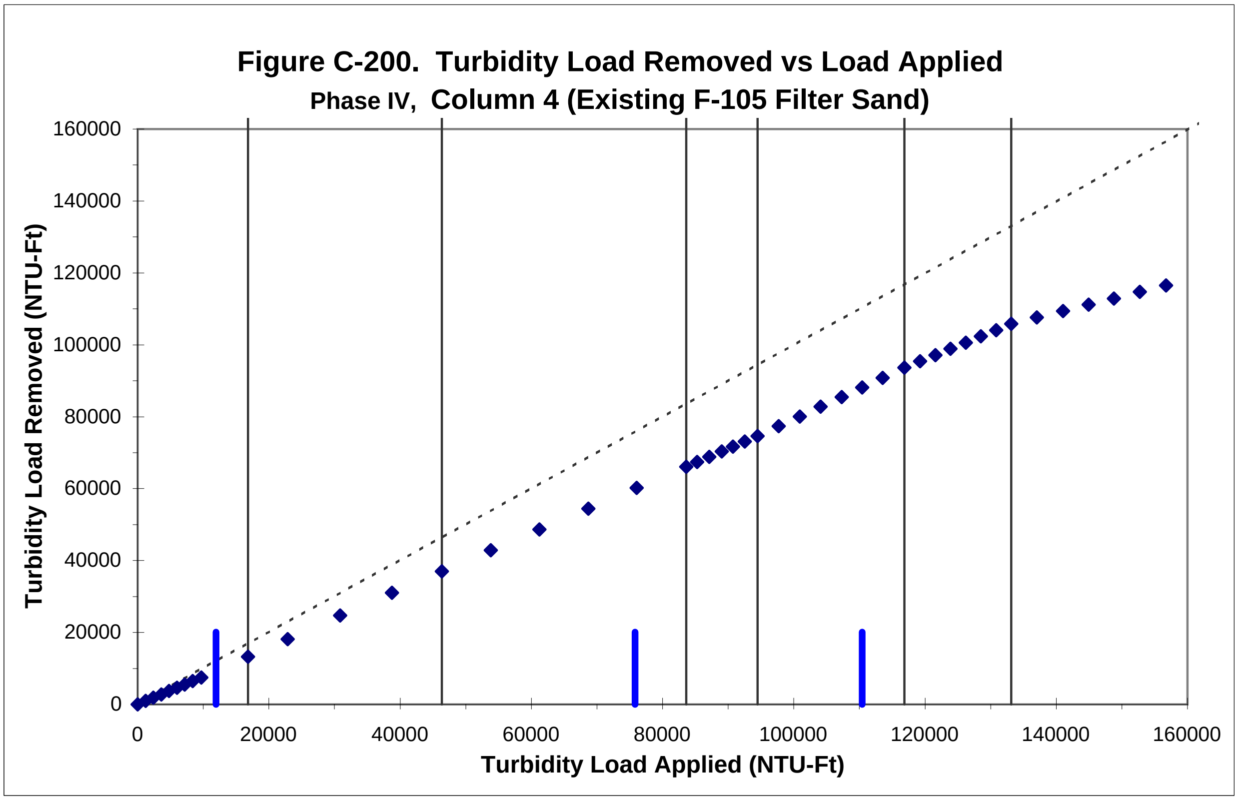
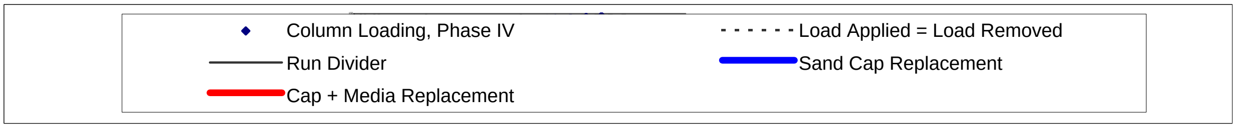


Figure C-200. Turbidity Load Removed vs Load Applied
Phase IV, Column 4 (Existing F-105 Filter Sand)
Turbidity Load Removed (NTU-Ft)
Turbidity Load Applied (NTU-Ft)
0
20000
40000
60000
80000
100000
120000
140000
160000


Column Loading, Phase IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

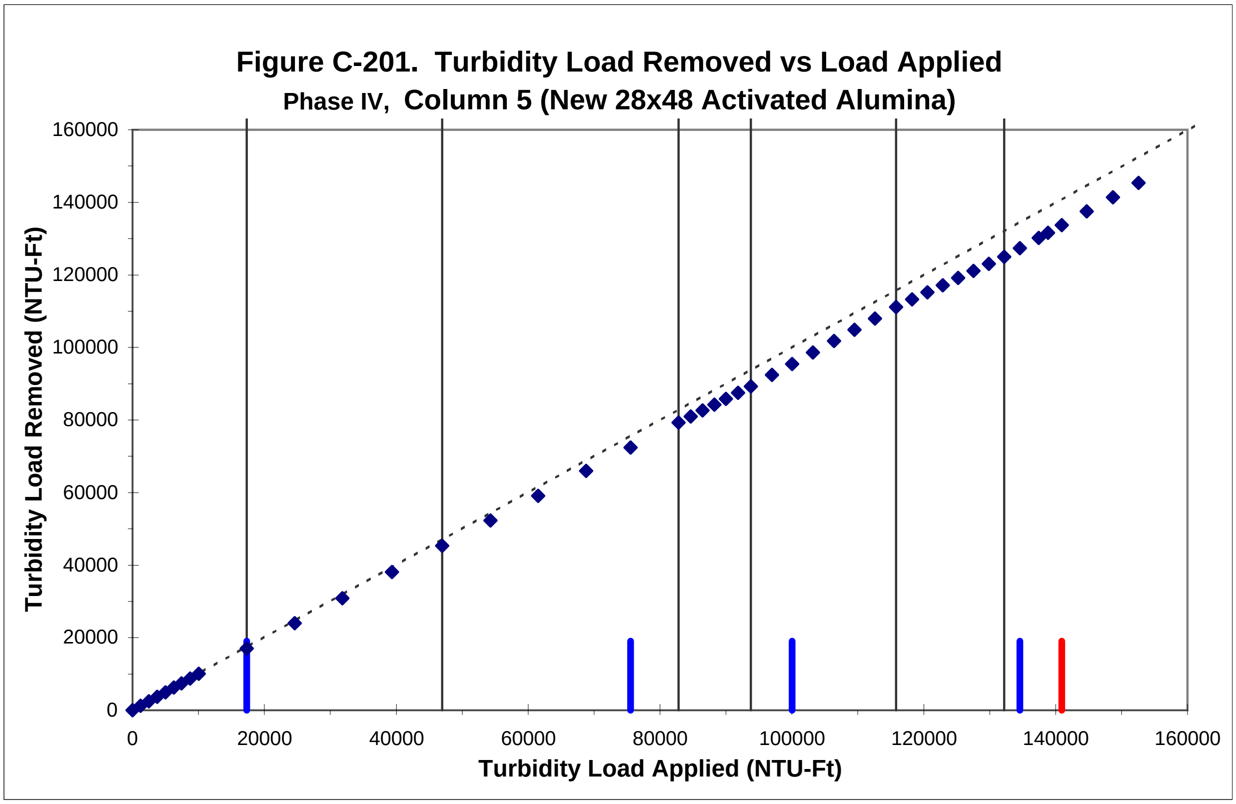


Figure C-201. Turbidity Load Removed vs Load Applied
Phase IV, Column 5 (New 28x48 Activated Alumina)
Turbidity Load Removed (NTU-Ft)
Turbidity Load Applied (NTU-Ft)
0
20000
40000
60000
80000
100000
120000
140000
160000

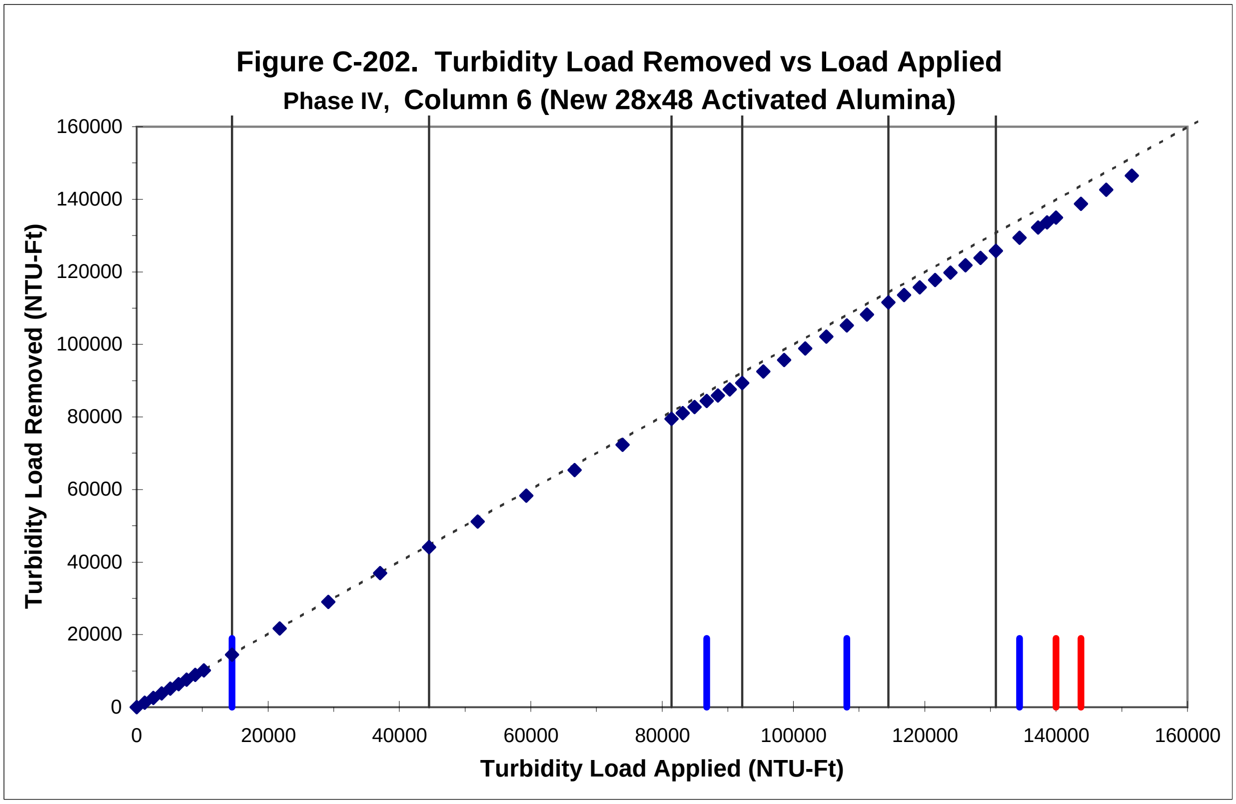
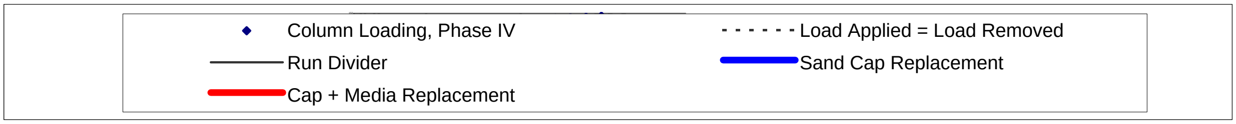


Figure C-202. Turbidity Load Removed vs Load Applied
Phase IV, Column 6 (New 28x48 Activated Alumina)
Turbidity Load Removed (NTU-Ft)
Turbidity Load Applied (NTU-Ft)
0
20000
40000
60000
80000
100000
120000
140000
160000


Column Loading, Phase IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

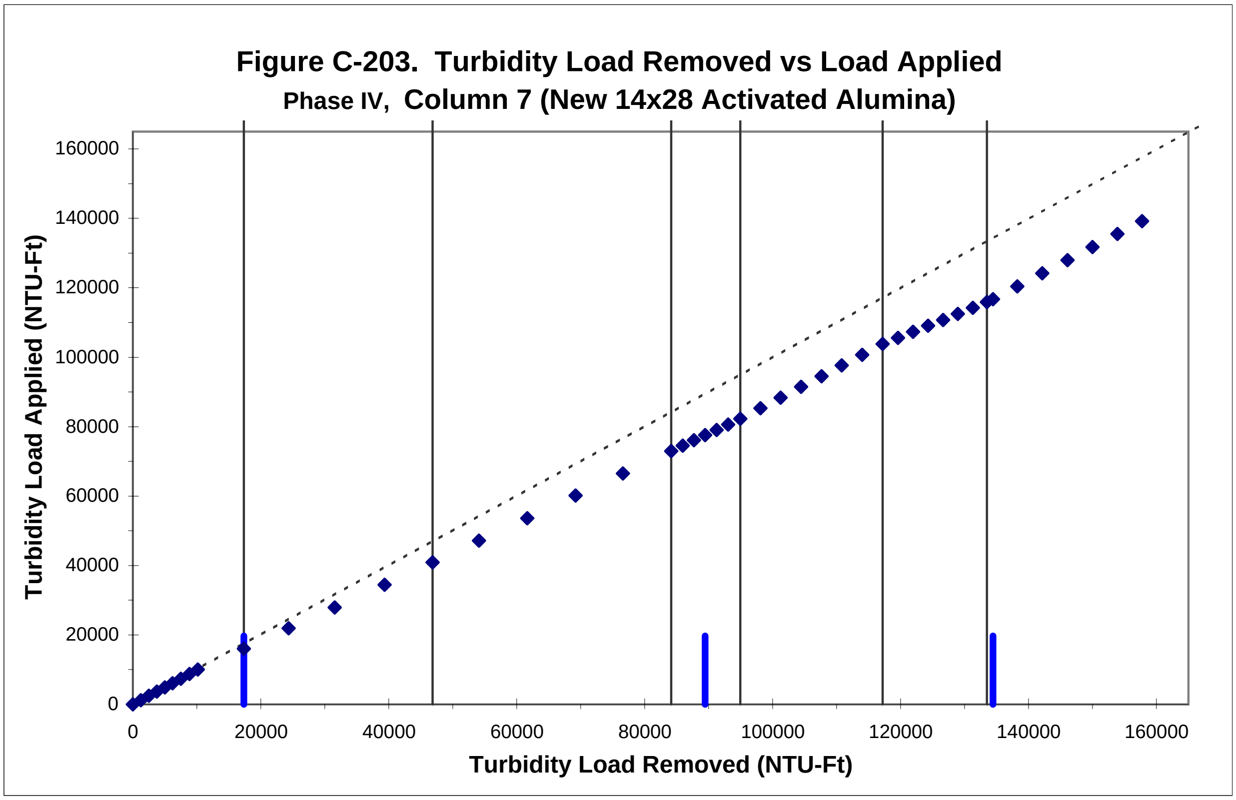


Figure C-203. Turbidity Load Removed vs Load Applied
Phase IV, Column 7 (New 14x28 Activated Alumina)
Turbidity Load Applied (NTU-Ft)
Turbidity Load Removed (NTU-Ft)
0
20000
40000
60000
80000
100000
120000
140000
160000

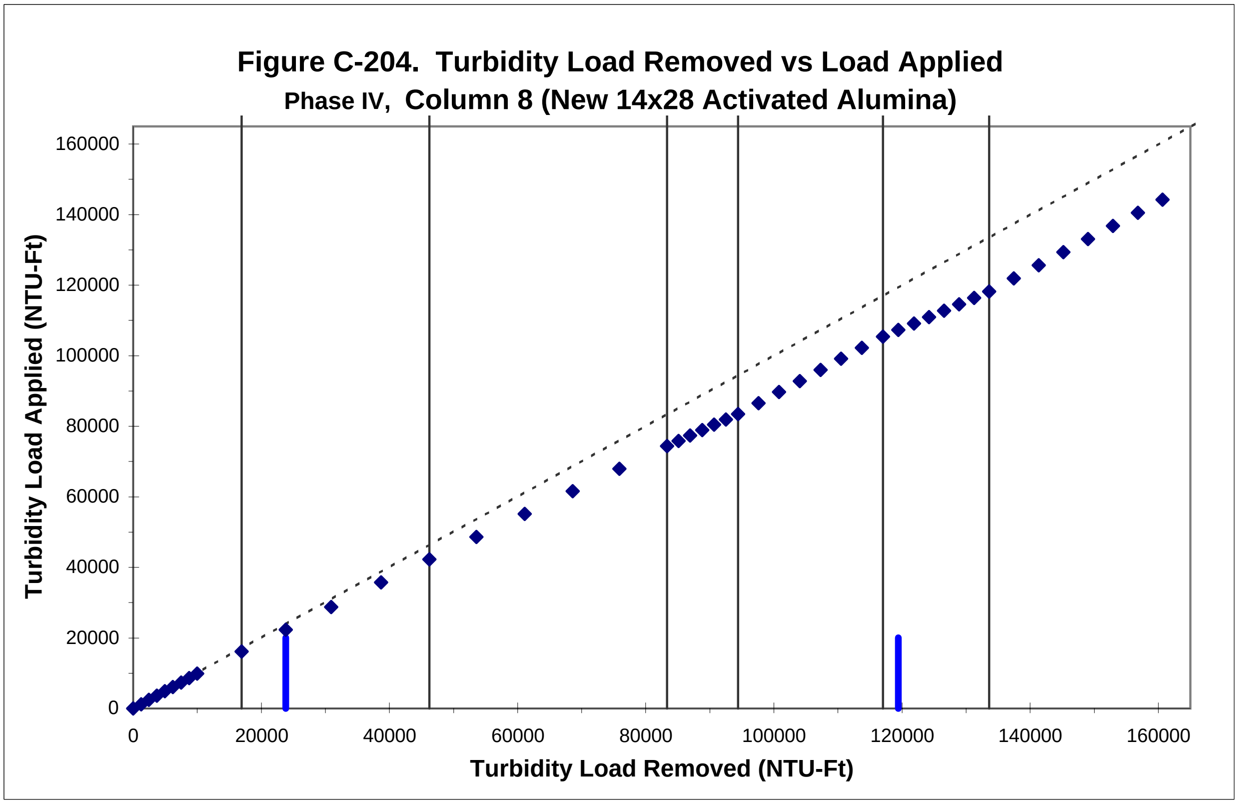
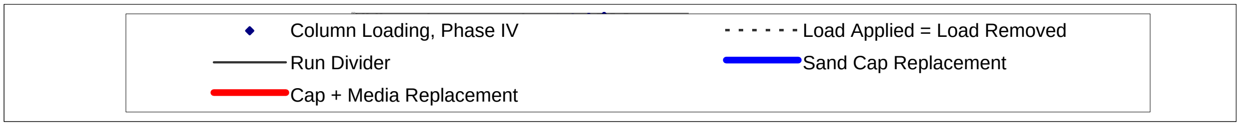


Figure C-204. Turbidity Load Removed vs Load Applied
Phase IV, Column 8 (New 14x28 Activated Alumina)
Turbidity Load Applied (NTU-Ft)
Turbidity Load Removed (NTU-Ft)
0
20000
40000
60000
80000
100000
120000
140000
160000


Column Loading, Phase IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

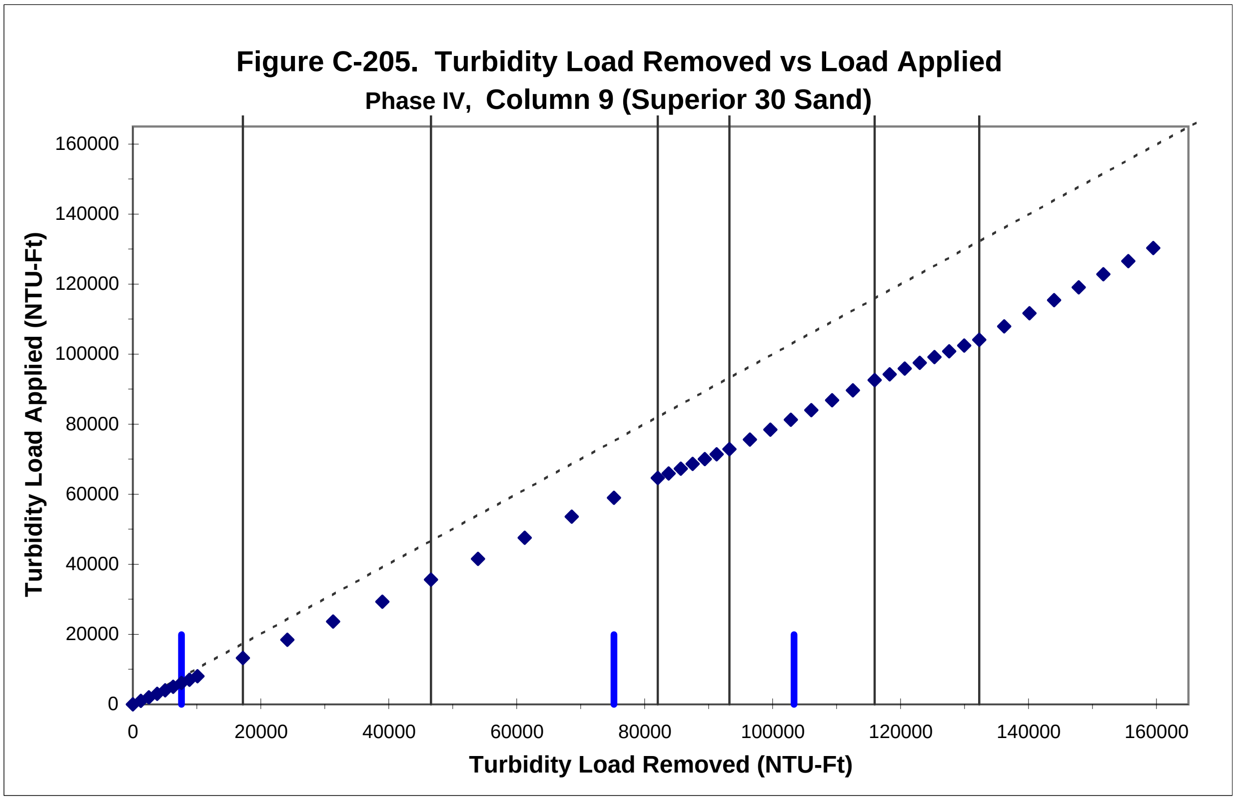


Figure C-205. Turbidity Load Removed vs Load Applied
Phase IV, Column 9 (Superior 30 Sand)
Turbidity Load Applied (NTU-Ft)
Turbidity Load Removed (NTU-Ft)
0
20000
40000
60000
80000
100000
120000
140000
160000

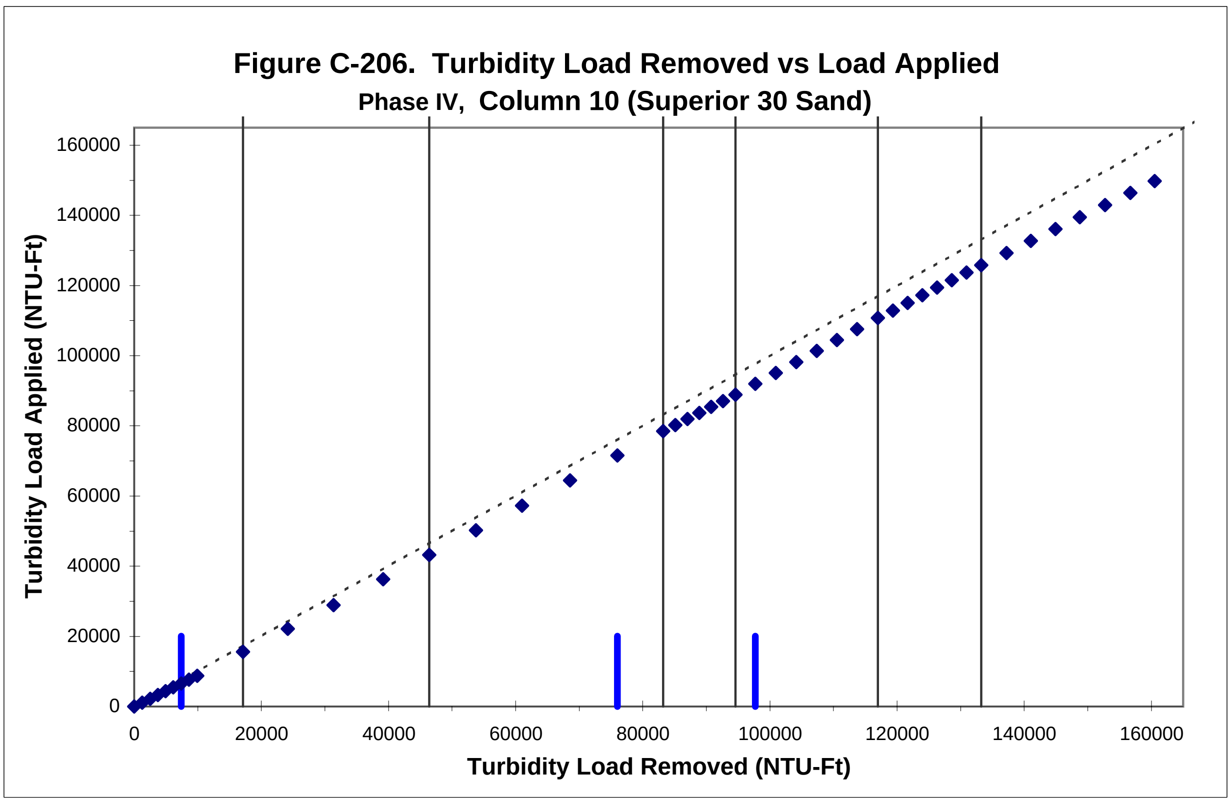
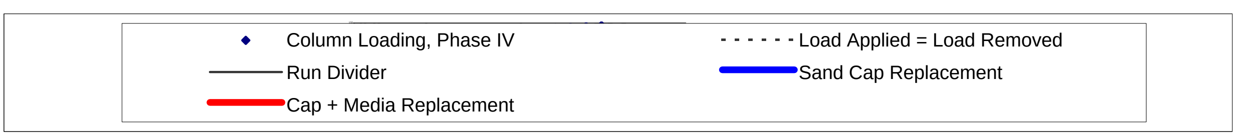


Figure C-206. Turbidity Load Removed vs Load Applied
Phase IV, Column 10 (Superior 30 Sand)
Turbidity Load Applied (NTU-Ft)
Turbidity Load Removed (NTU-Ft)
0
20000
40000
60000
80000
100000
120000
140000
160000


Column Loading, Phase IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

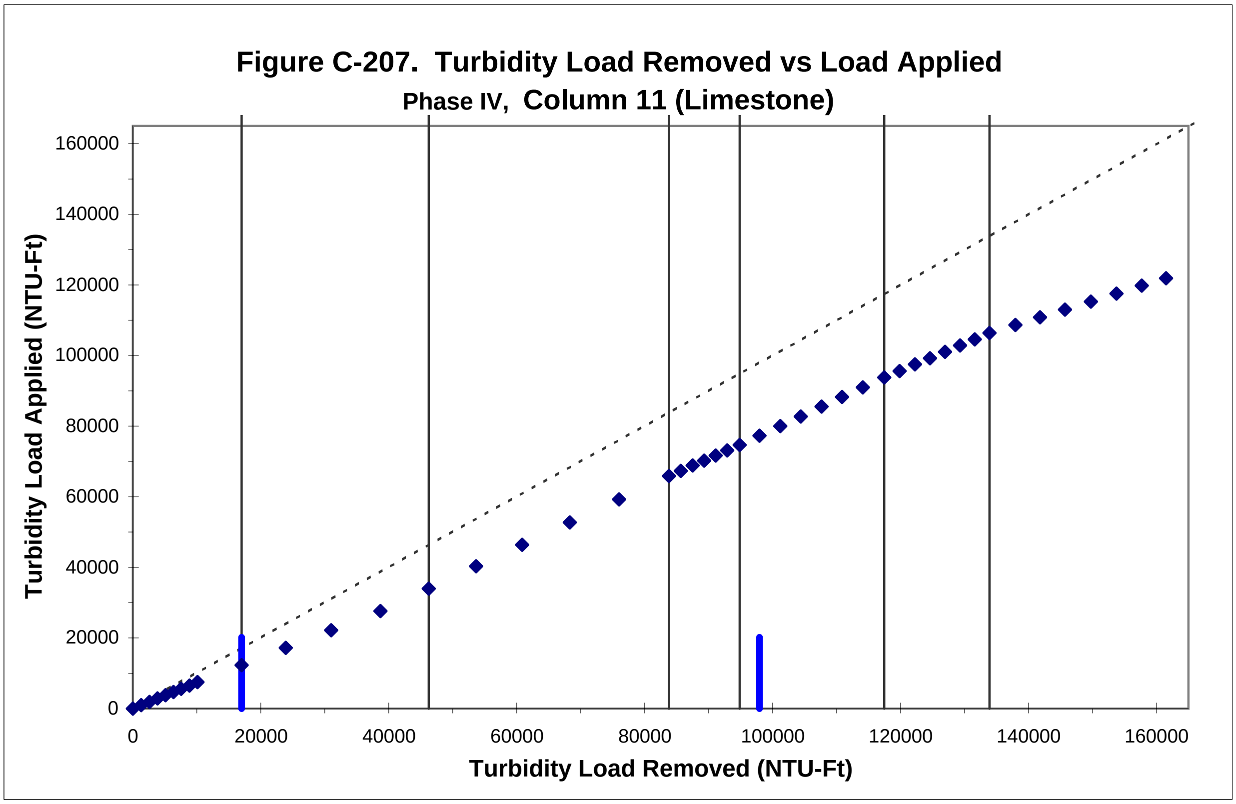


Figure C-207. Turbidity Load Removed vs Load Applied
Phase IV, Column 11 (Limestone)
Turbidity Load Applied (NTU-Ft)
Turbidity Load Removed (NTU-Ft)
0
20000
40000
60000
80000
100000
120000
140000
160000

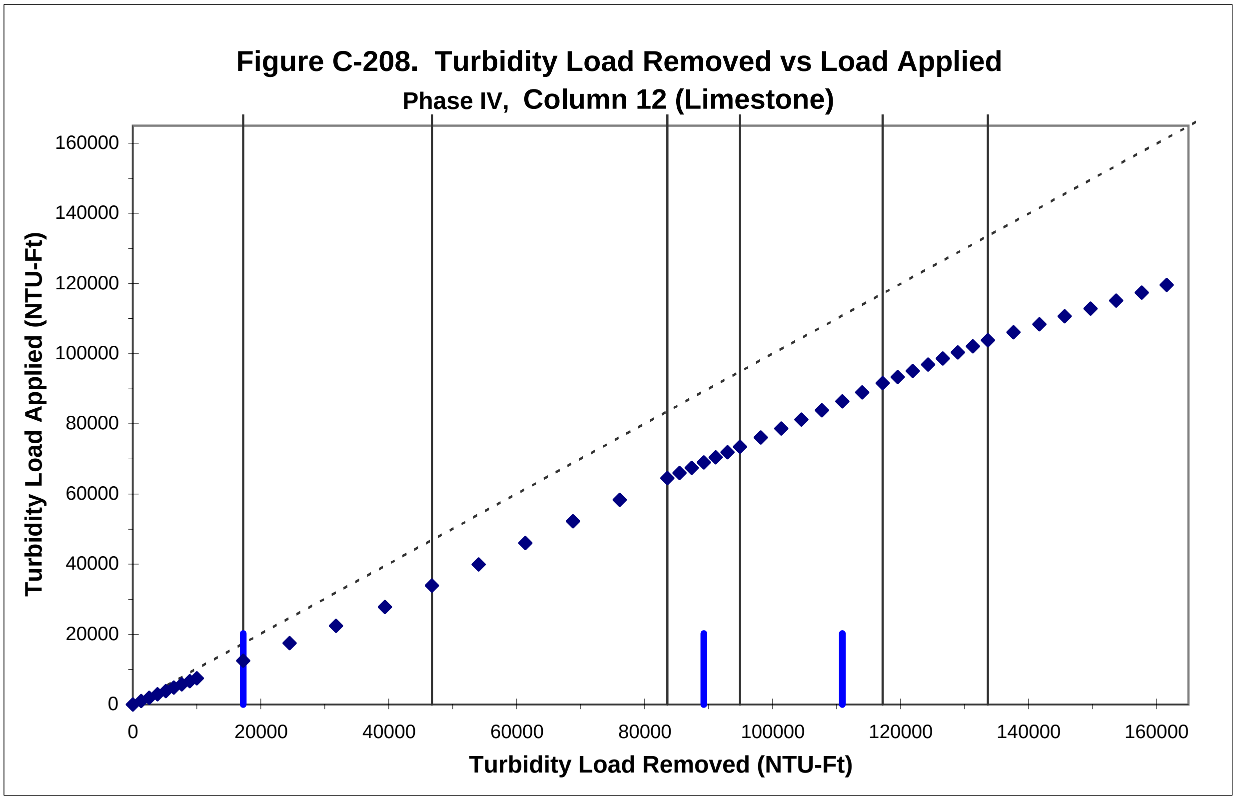
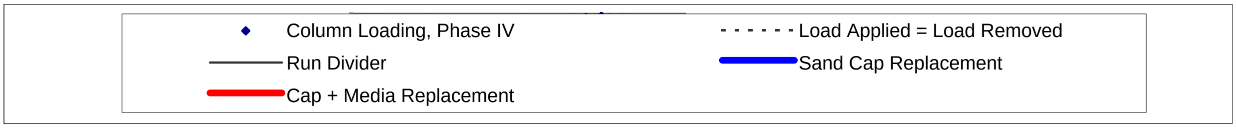


Figure C-208. Turbidity Load Removed vs Load Applied
Phase IV, Column 12 (Limestone)
Turbidity Load Applied (NTU-Ft)
Turbidity Load Removed (NTU-Ft)
0
20000
40000
60000
80000
100000
120000
140000
160000


Column Loading, Phase IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

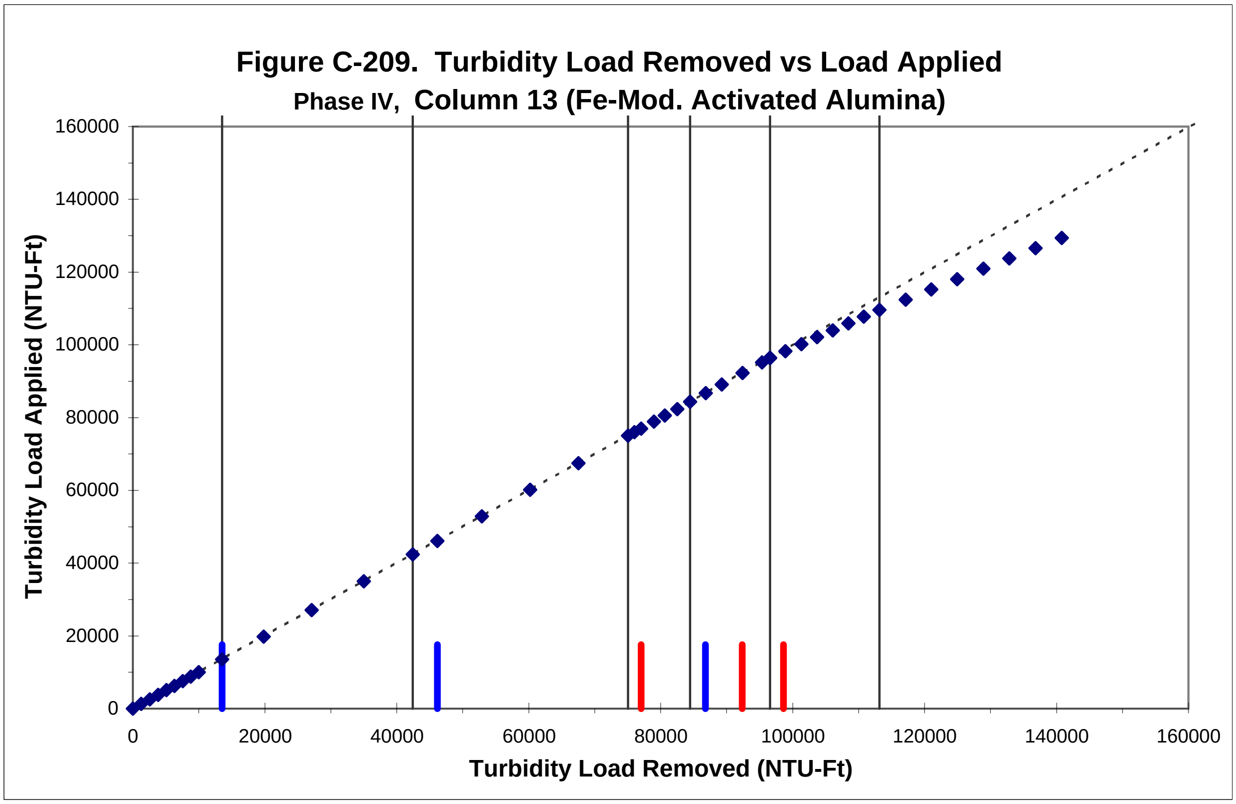


Figure C-209. Turbidity Load Removed vs Load Applied
Phase IV, Column 13 (Fe-Mod. Activated Alumina)
Turbidity Load Applied (NTU-Ft)
Turbidity Load Removed (NTU-Ft)
0
20000
40000
60000
80000
100000
120000
140000
160000

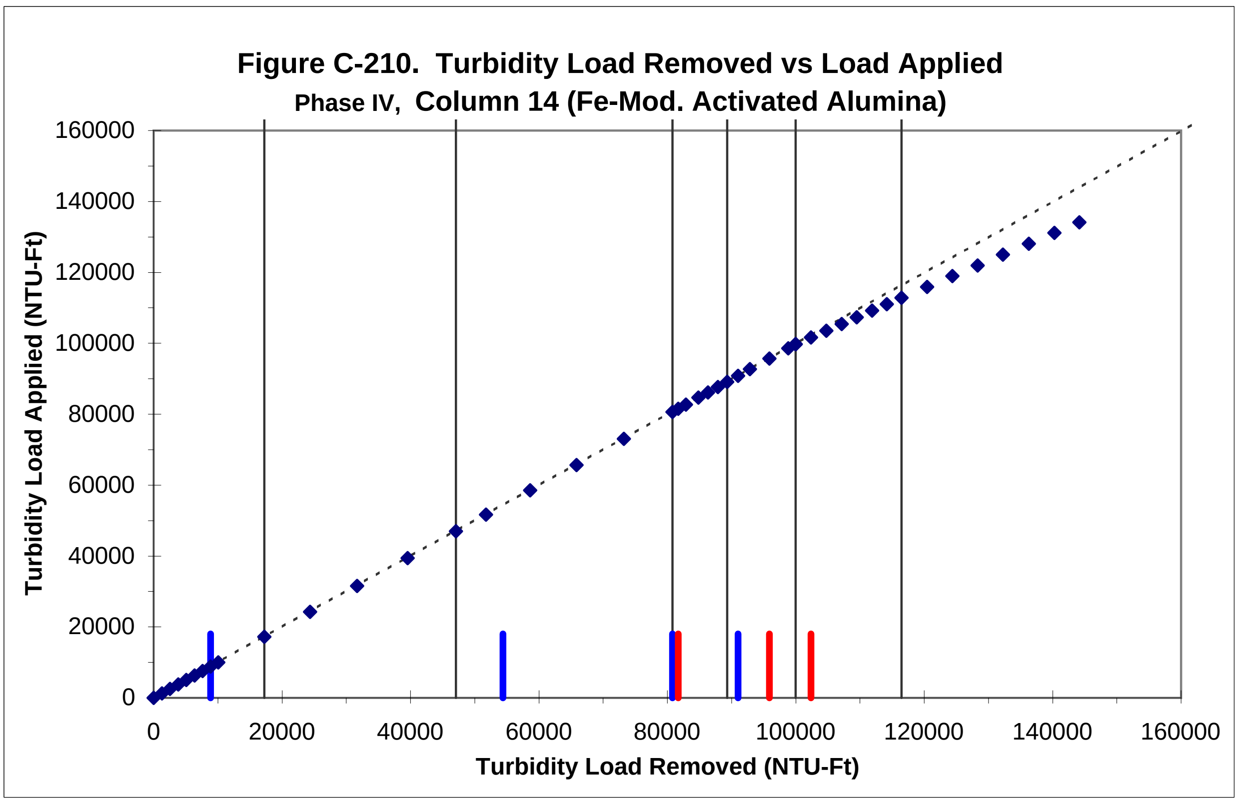
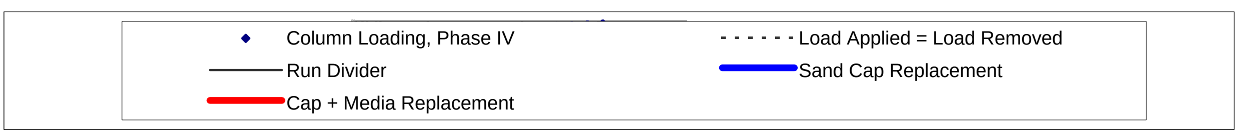


Figure C-210. Turbidity Load Removed vs Load Applied
Phase IV, Column 14 (Fe-Mod. Activated Alumina)
Turbidity Load Applied (NTU-Ft)
Turbidity Load Removed (NTU-Ft)
0
20000
40000
60000
80000
100000
120000
140000
160000


Column Loading, Phase IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

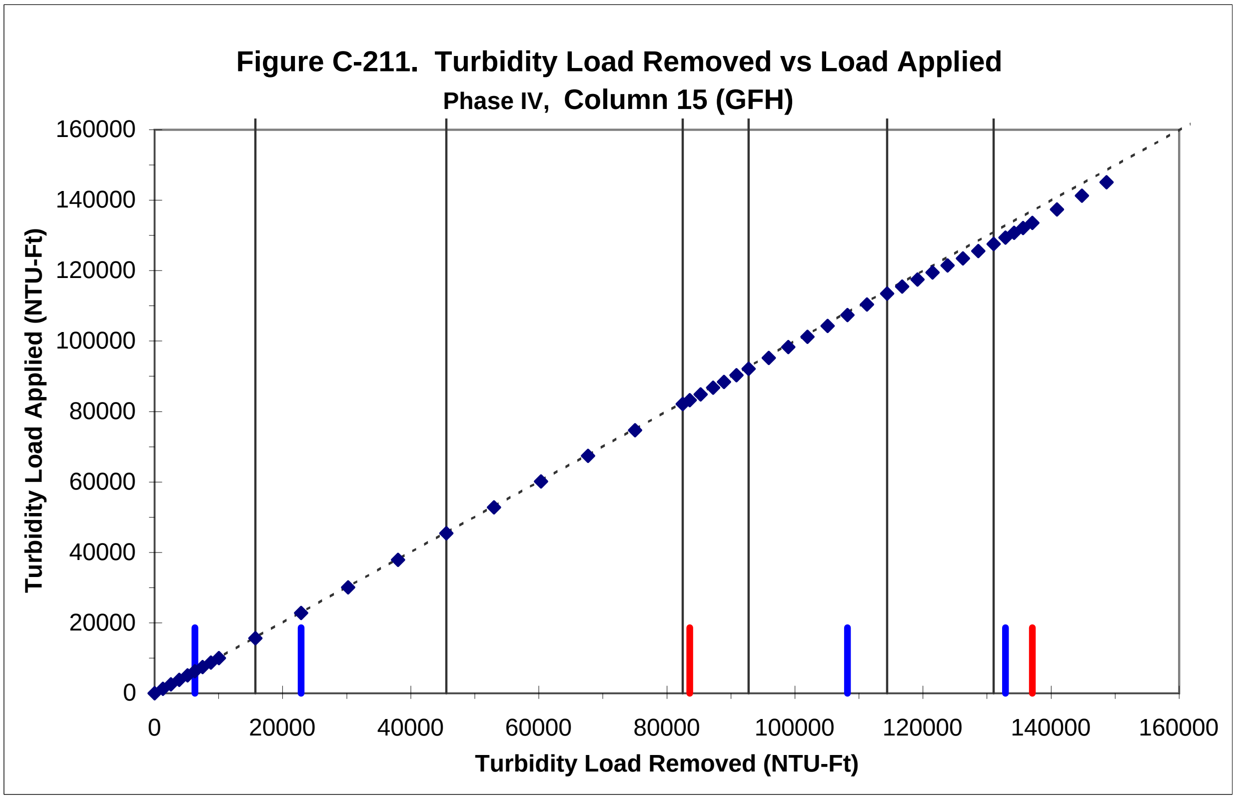


Figure C-211. Turbidity Load Removed vs Load Applied
Phase IV, Column 15 (GFH)
Turbidity Load Applied (NTU-Ft)
0
20000
40000
60000
80000
100000
120000
140000
160000
Turbidity Load Removed (NTU-Ft)

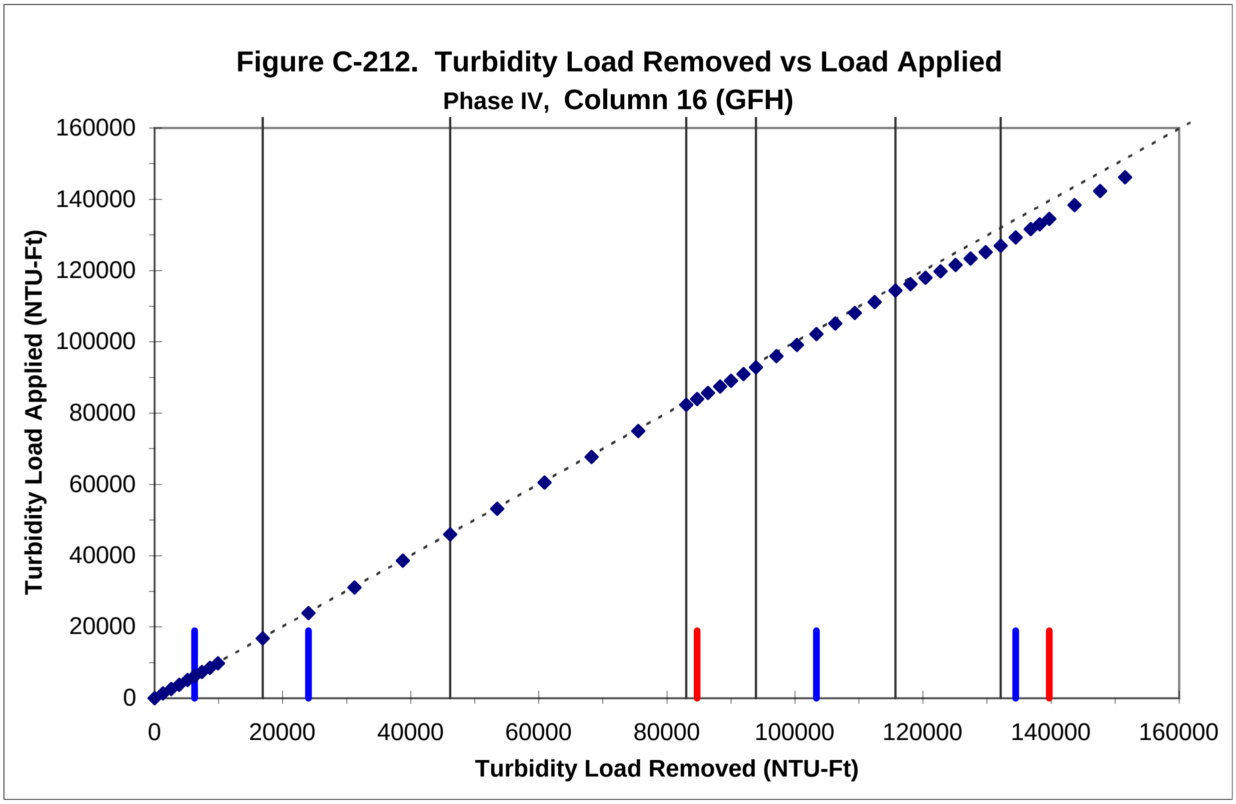
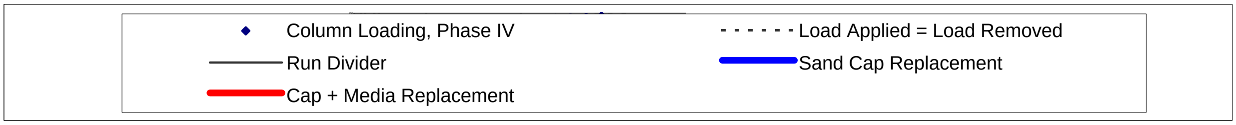


Figure C-212. Turbidity Load Removed vs Load Applied
Phase IV, Column 16 (GFH)
Turbidity Load Applied (NTU-Ft)
0
20000
40000
60000
80000
100000
120000
140000
160000
Turbidity Load Removed (NTU-Ft)


Column Loading, Phase IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

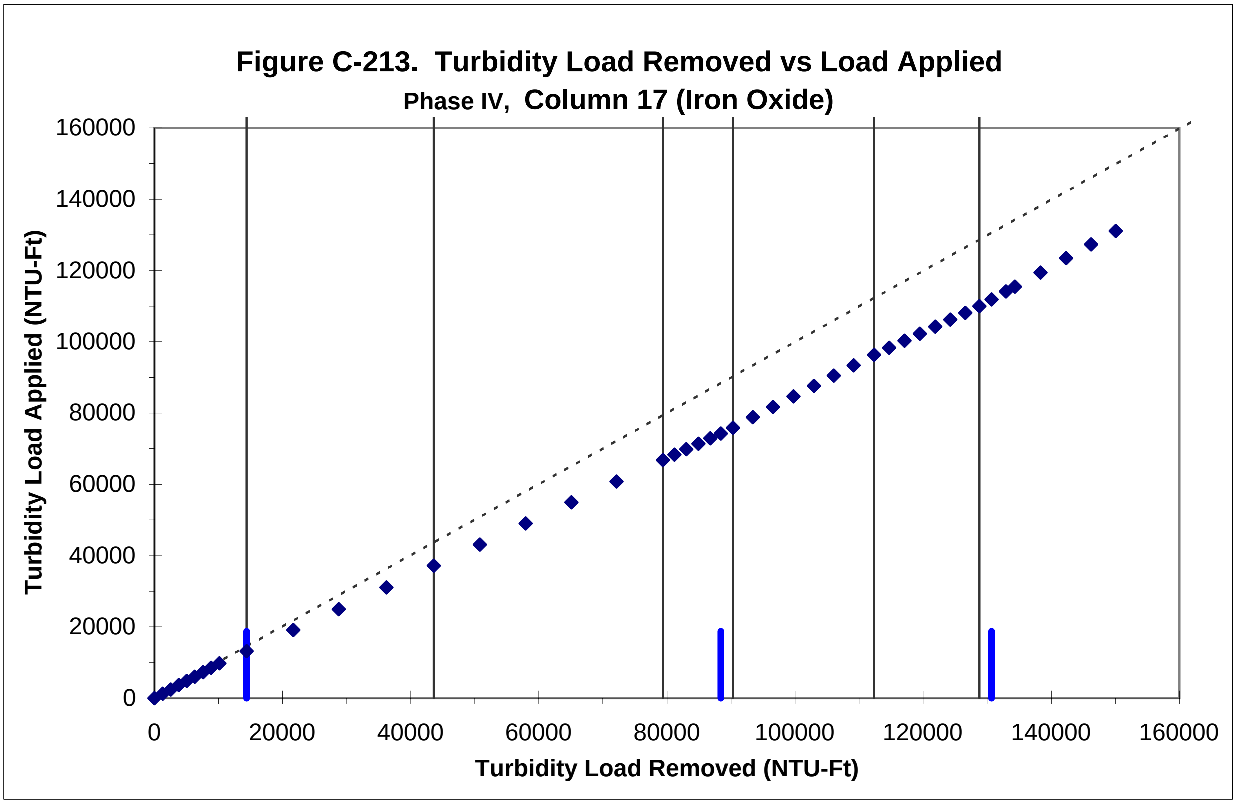


Figure C-213. Turbidity Load Removed vs Load Applied
Phase IV, Column 17 (Iron Oxide)
Turbidity Load Applied (NTU-Ft)
Turbidity Load Removed (NTU-Ft)
0
20000
40000
60000
80000
100000
120000
140000
160000

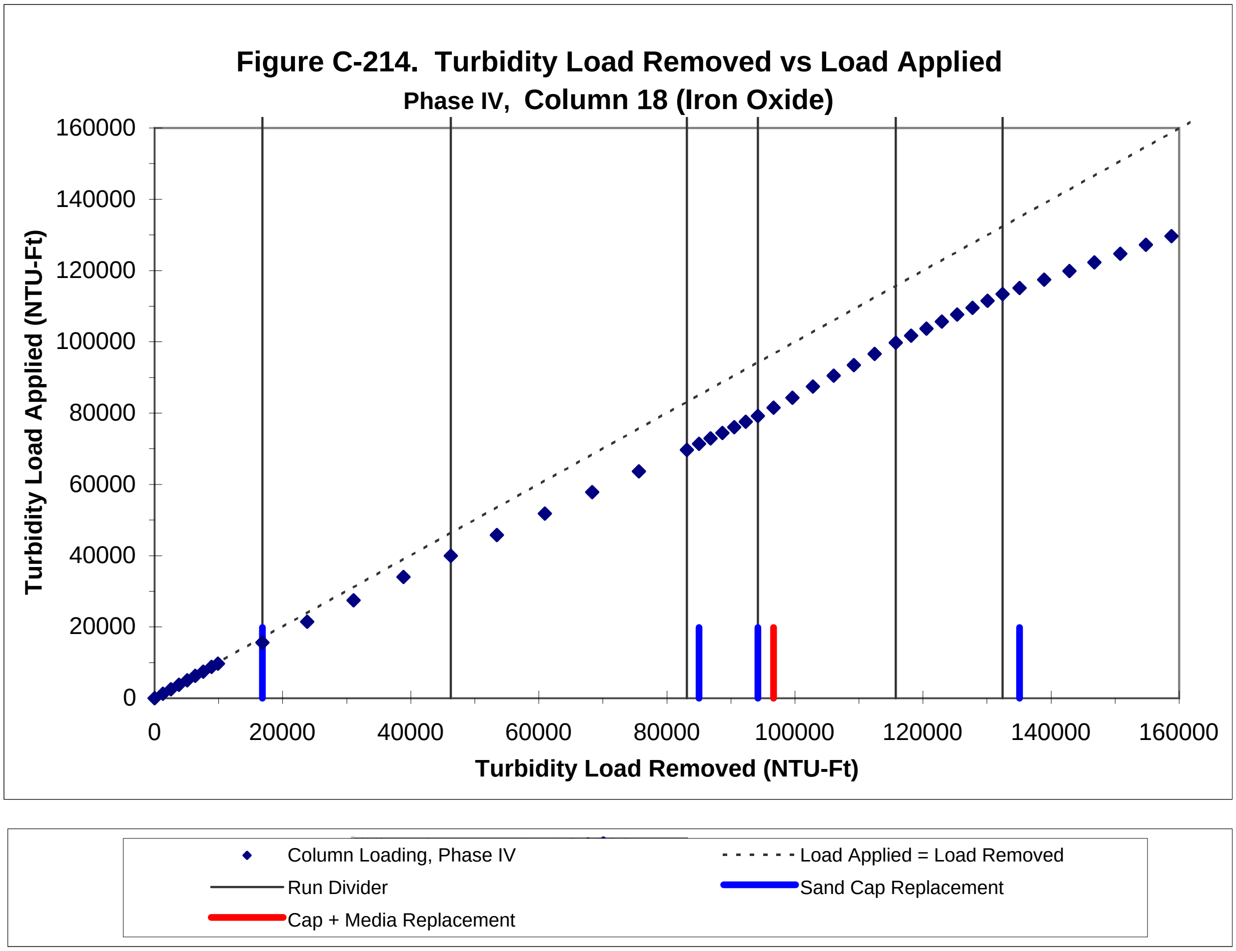


Figure C-214. Turbidity Load Removed vs Load Applied
Phase IV, Column 18 (Iron Oxide)
Turbidity Load Applied (NTU-Ft)
Turbidity Load Removed (NTU-Ft)
0
20000
40000
60000
80000
100000
120000
140000
160000
Column Loading, Phase IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

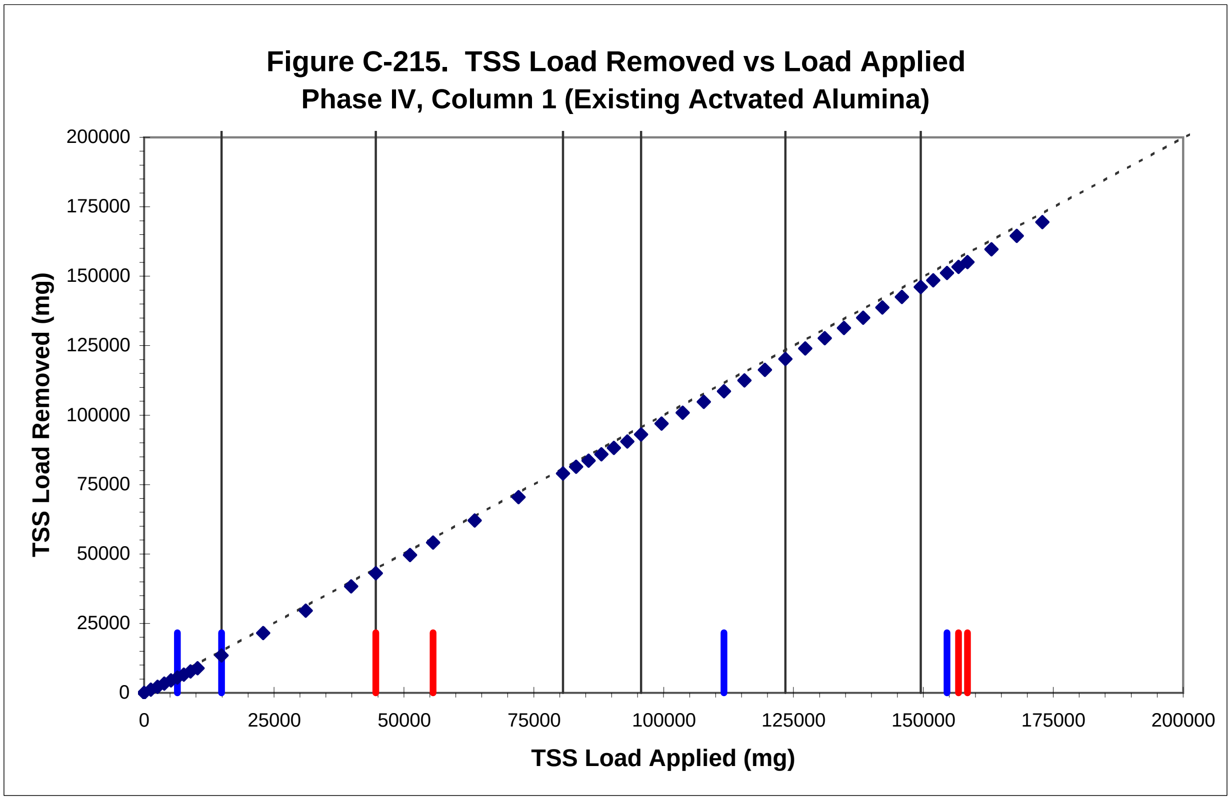


Figure C-215. TSS Load Removed vs Load Applied
Phase IV, Column 1 (Existing Actvated Alumina)
TSS Load Removed (mg)
200000
175000
150000
125000
100000
75000
50000
25000
0
0
25000
50000
75000
100000
125000
150000
175000
200000
TSS Load Applied (mg)

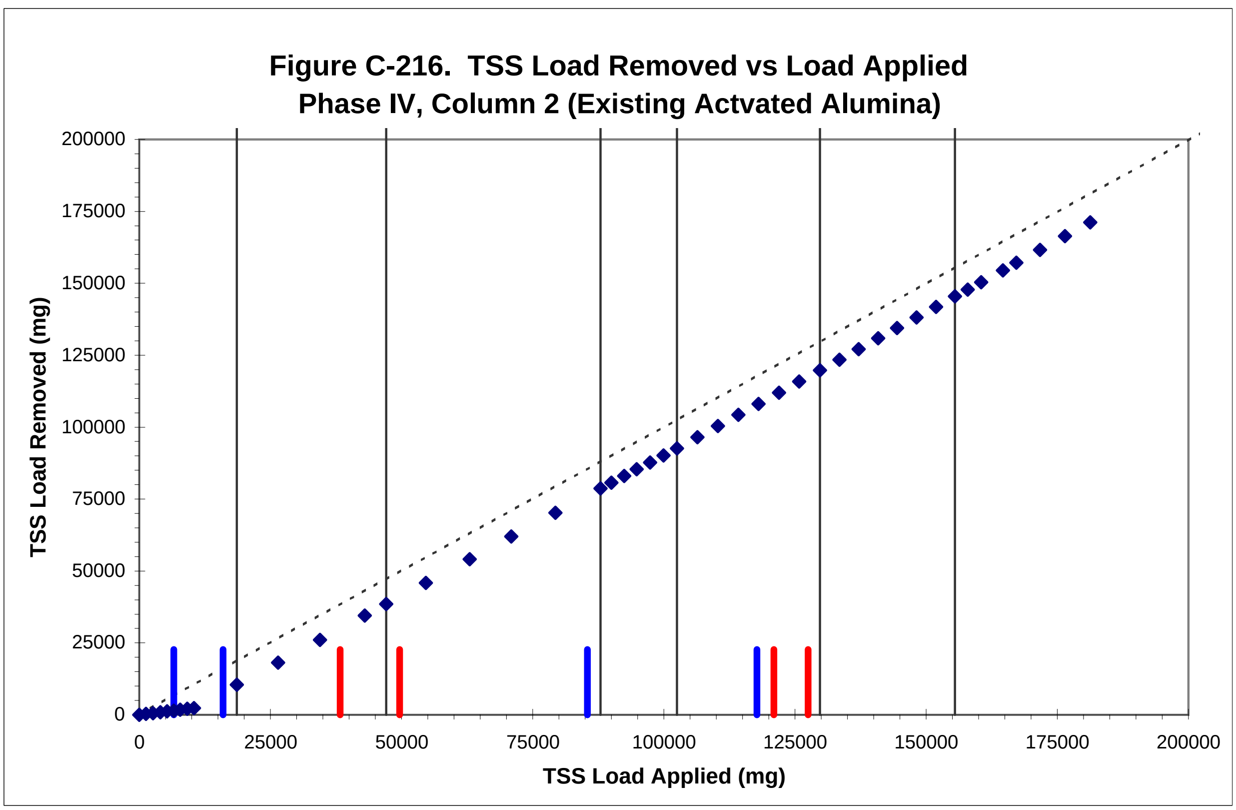
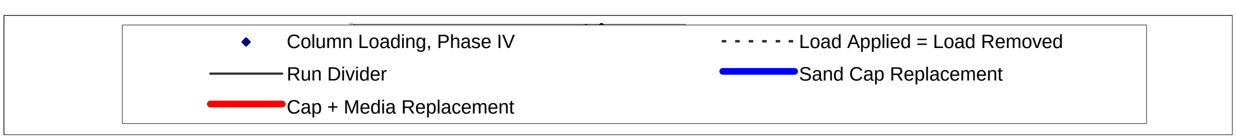


Figure C-216. TSS Load Removed vs Load Applied
Phase IV, Column 2 (Existing Actvated Alumina)
TSS Load Removed (mg)
200000
175000
150000
125000
100000
75000
50000
25000
0
0
25000
50000
75000
100000
125000
150000
175000
200000
TSS Load Applied (mg)


Column Loading, Phase IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

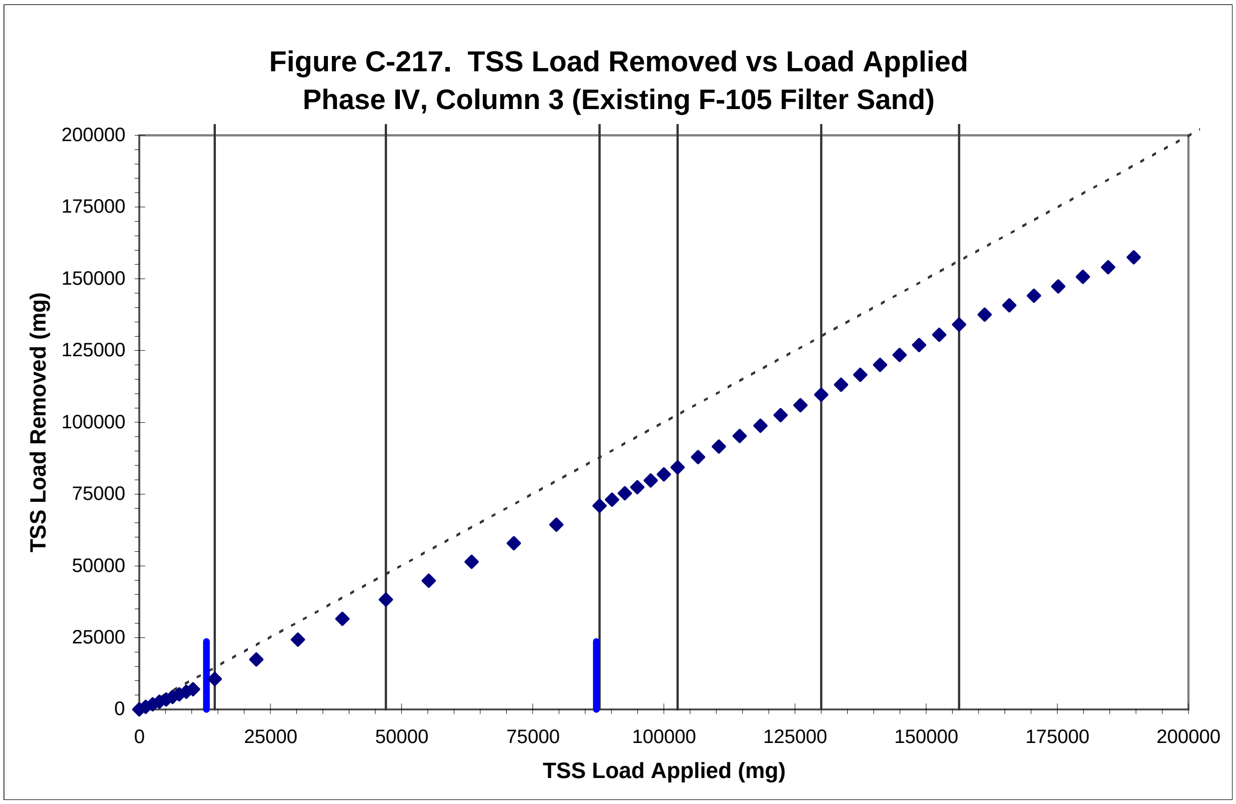


Figure C-217. TSS Load Removed vs Load Applied
Phase IV, Column 3 (Existing F-105 Filter Sand)
TSS Load Removed (mg)
TSS Load Applied (mg)
0
25000
50000
75000
100000
125000
150000
175000
200000

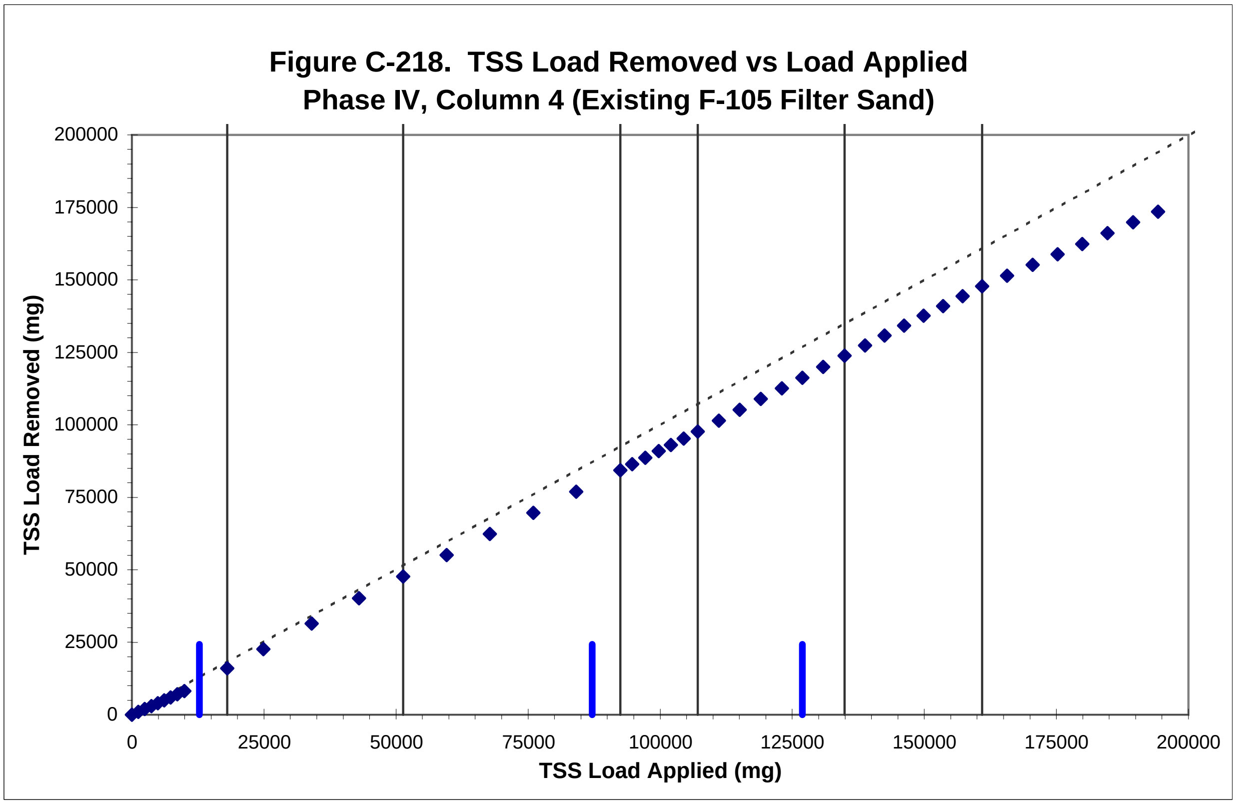
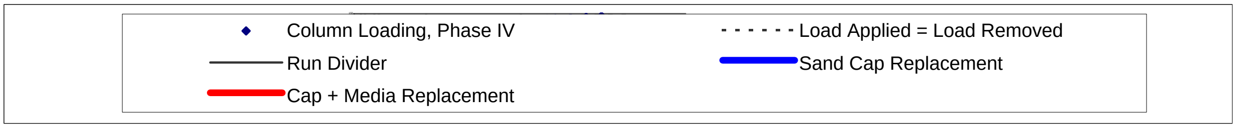


Figure C-218. TSS Load Removed vs Load Applied
Phase IV, Column 4 (Existing F-105 Filter Sand)
TSS Load Removed (mg)
TSS Load Applied (mg)
0
25000
50000
75000
100000
125000
150000
175000
200000


Column Loading, Phase IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

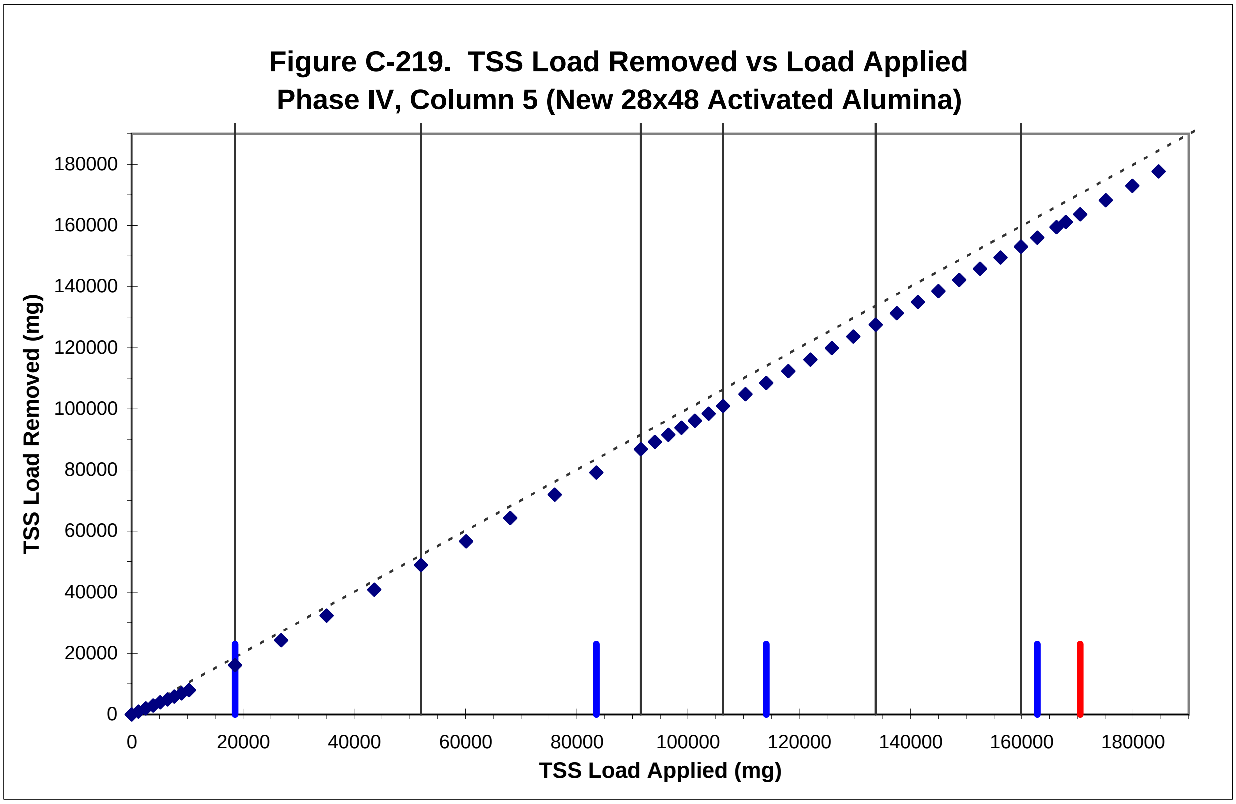


Figure C-219. TSS Load Removed vs Load Applied
Phase IV, Column 5 (New 28x48 Activated Alumina)
TSS Load Removed (mg)
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
0
20000
40000
60000
80000
100000
120000
140000
160000
180000
TSS Load Applied (mg)

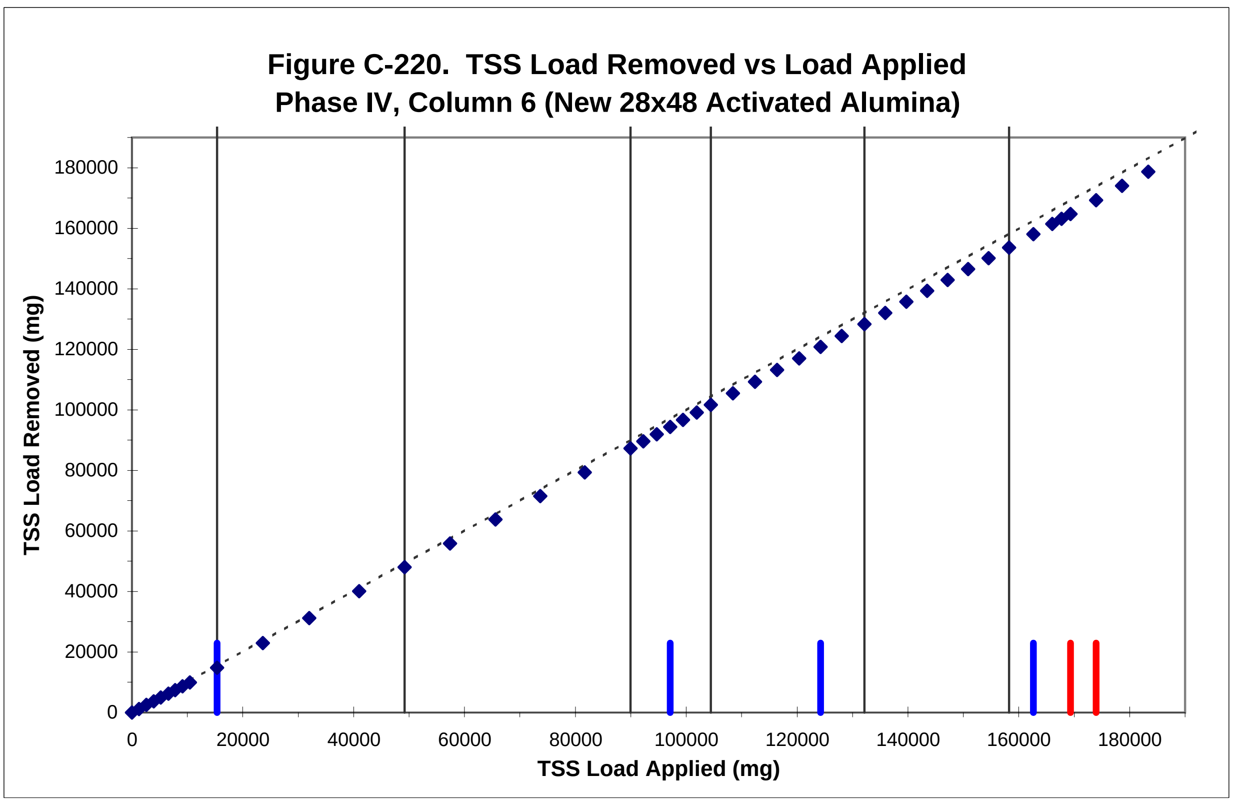


Figure C-220. TSS Load Removed vs Load Applied
Phase IV, Column 6 (New 28x48 Activated Alumina)
TSS Load Removed (mg)
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
0
20000
40000
60000
80000
100000
120000
140000
160000
180000
TSS Load Applied (mg)

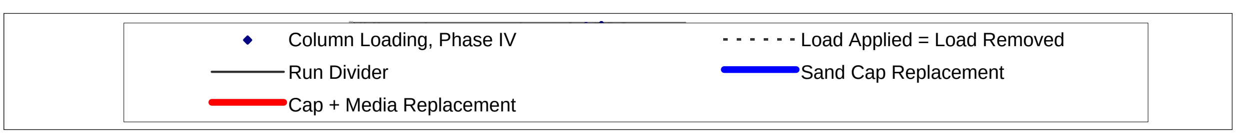

Column Loading, Phase IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

Figure C-221. TSS Load Removed vs Load Applied
Phase IV, Column 7 (New 14x28 Activated Alumina)

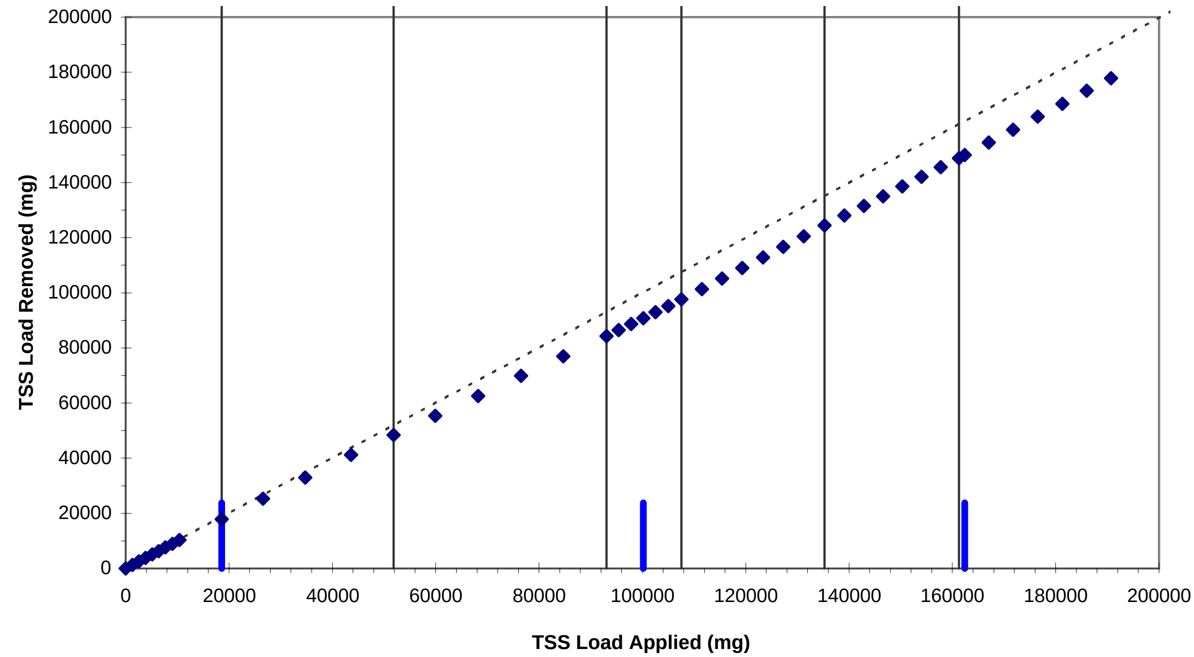
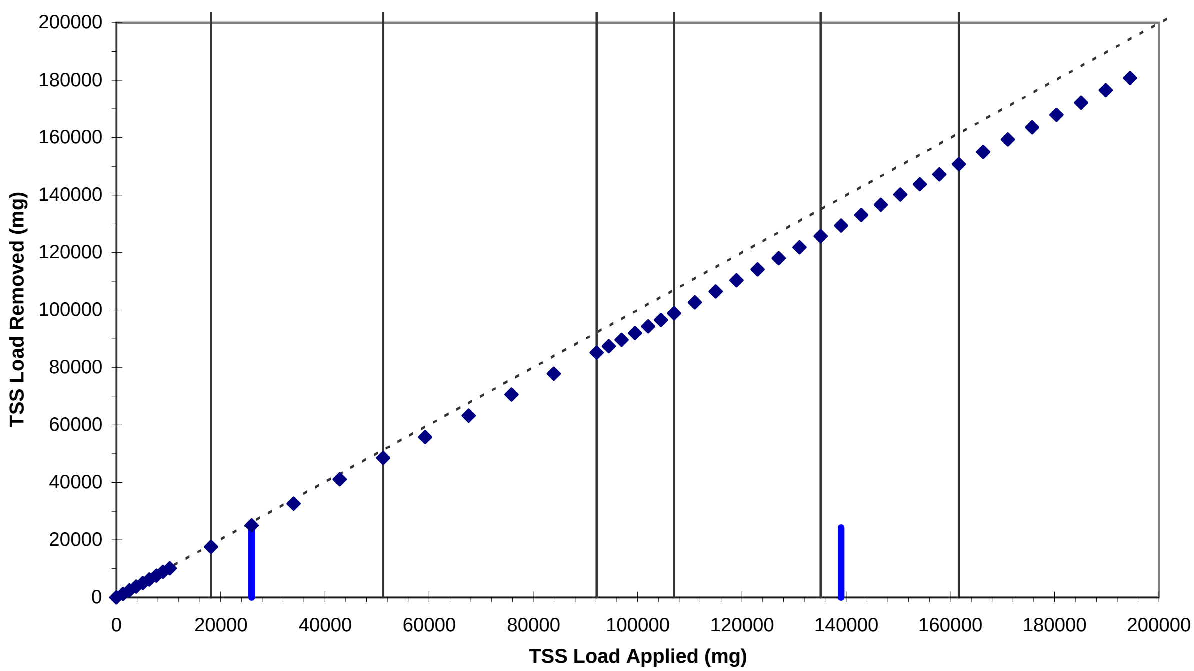


Figure C-222. TSS Load Removed vs Load Applied
Phase IV, Column 8 (New 14x28 Activated Alumina)



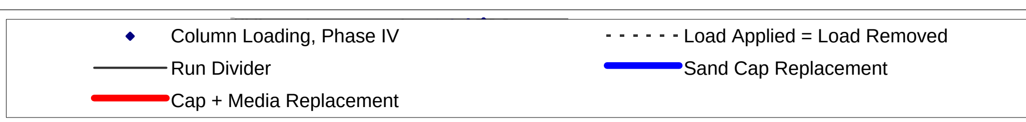


Figure C-223. TSS Load Removed vs Load Applied
Phase IV, Column 9 (Superior 30 Sand)

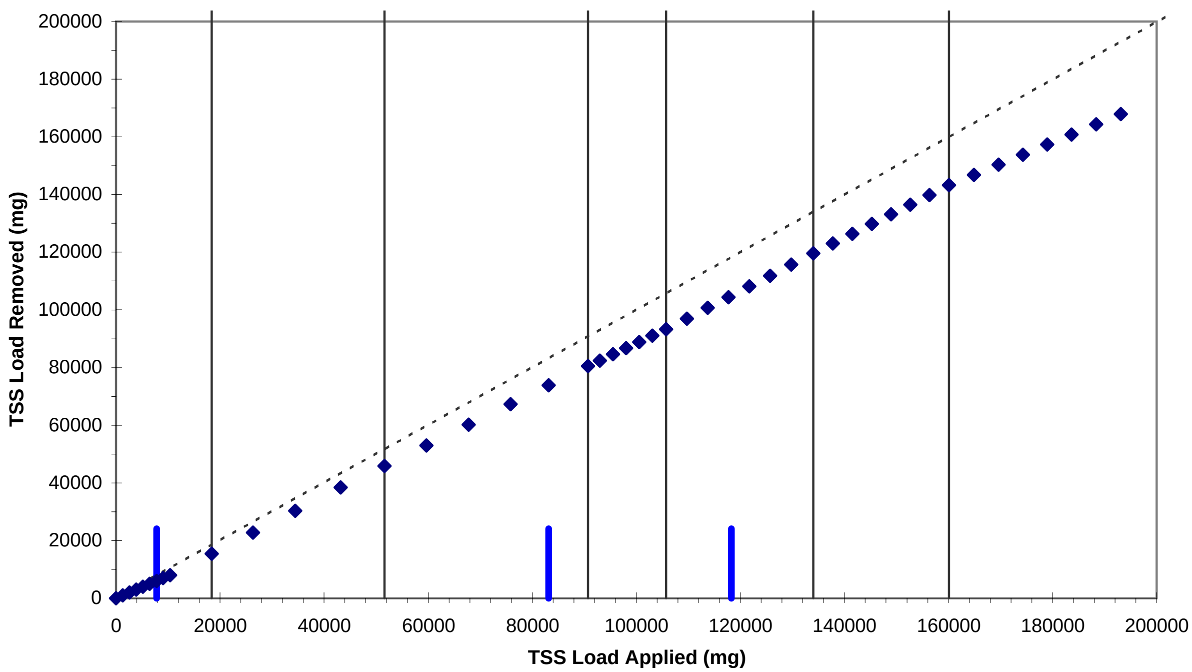
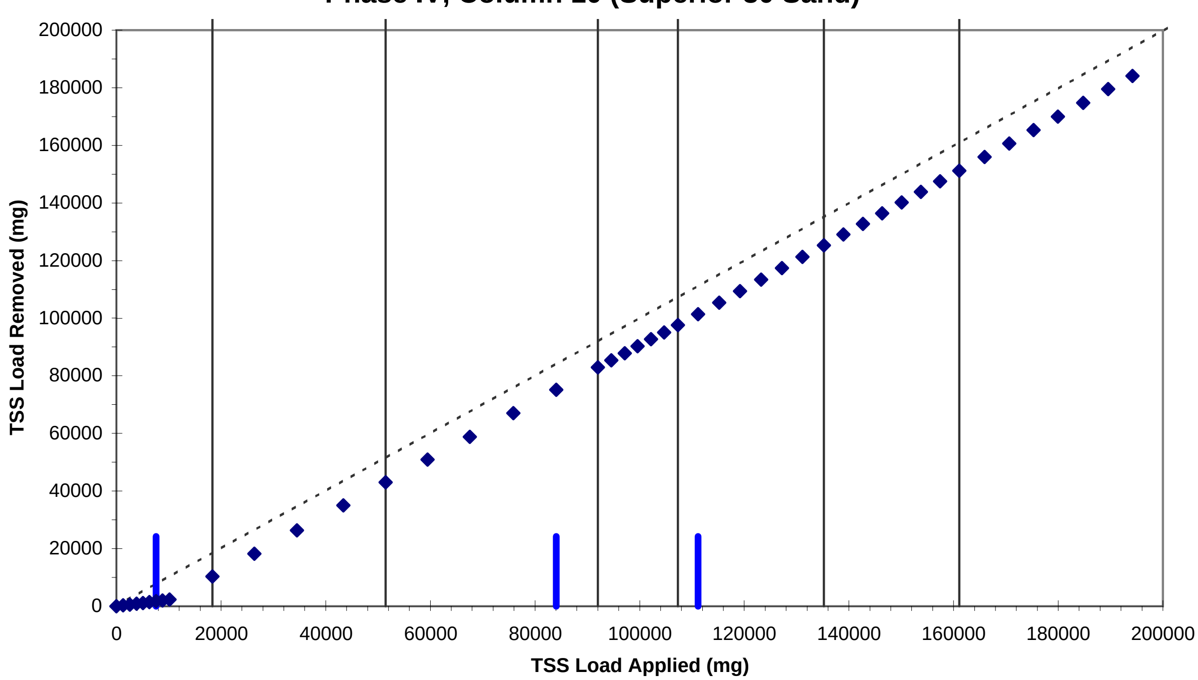


Figure C-224. TSS Load Removed vs Load Applied
Phase IV, Column 10 (Superior 30 Sand)



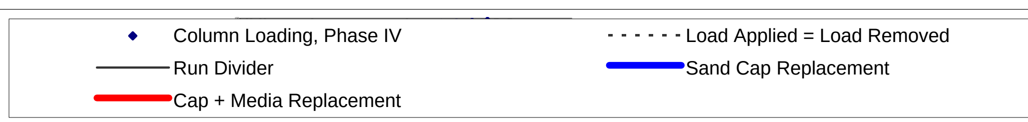


Figure C-225. TSS Load Removed vs Load Applied
Phase IV, Column 11 (Limestone)

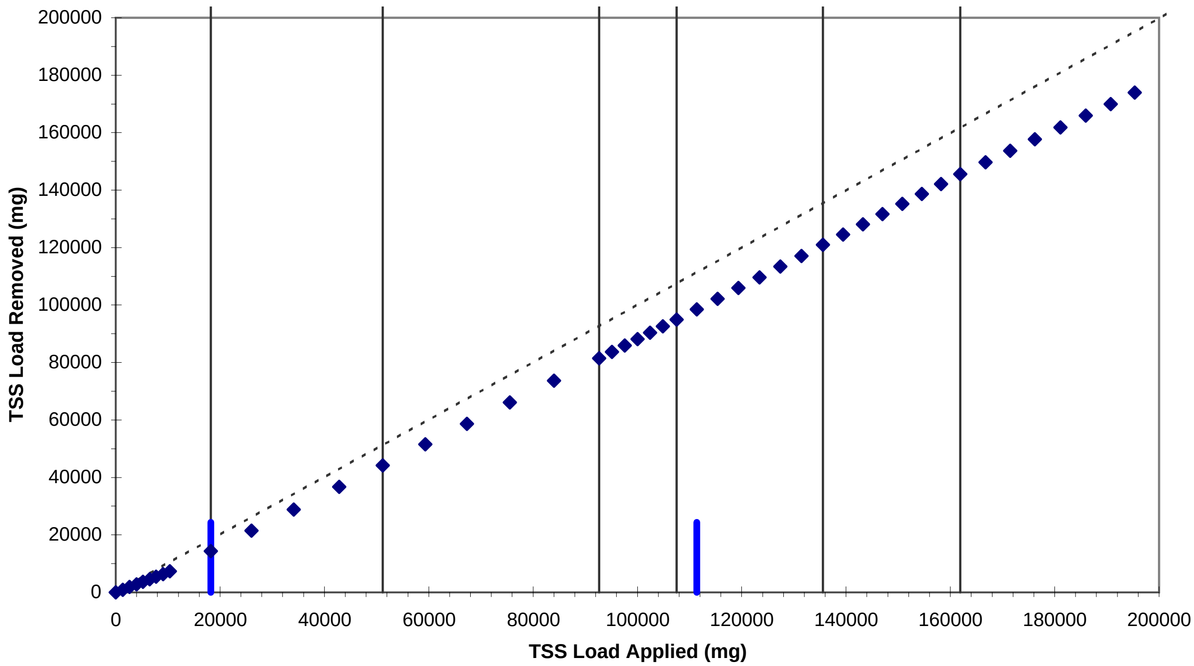
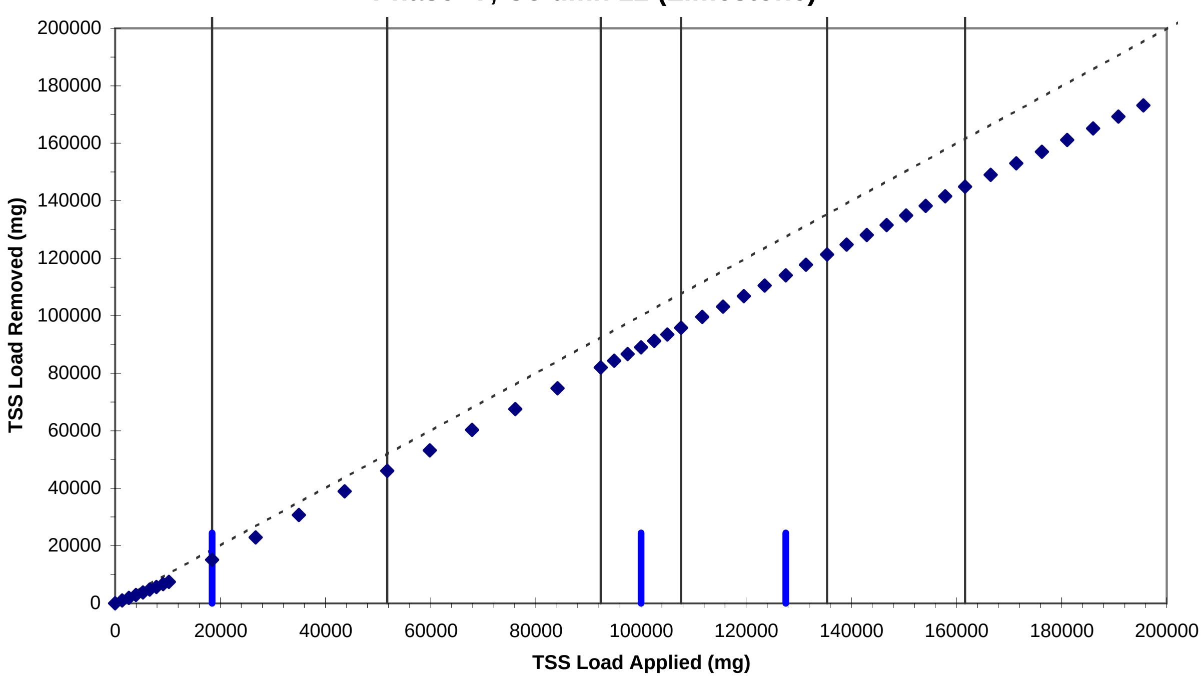


Figure C-226. TSS Load Removed vs Load Applied
Phase IV, Column 12 (Limestone)



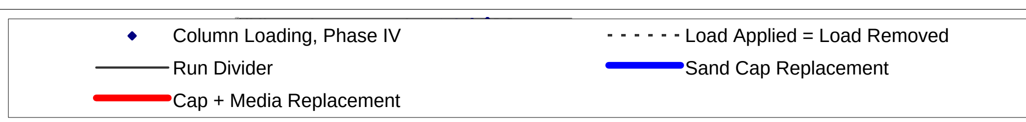


Figure C-227. TSS Load Removed vs Load Applied
Phase IV, Column 13 (Fe-Mod. Activated Alumina)

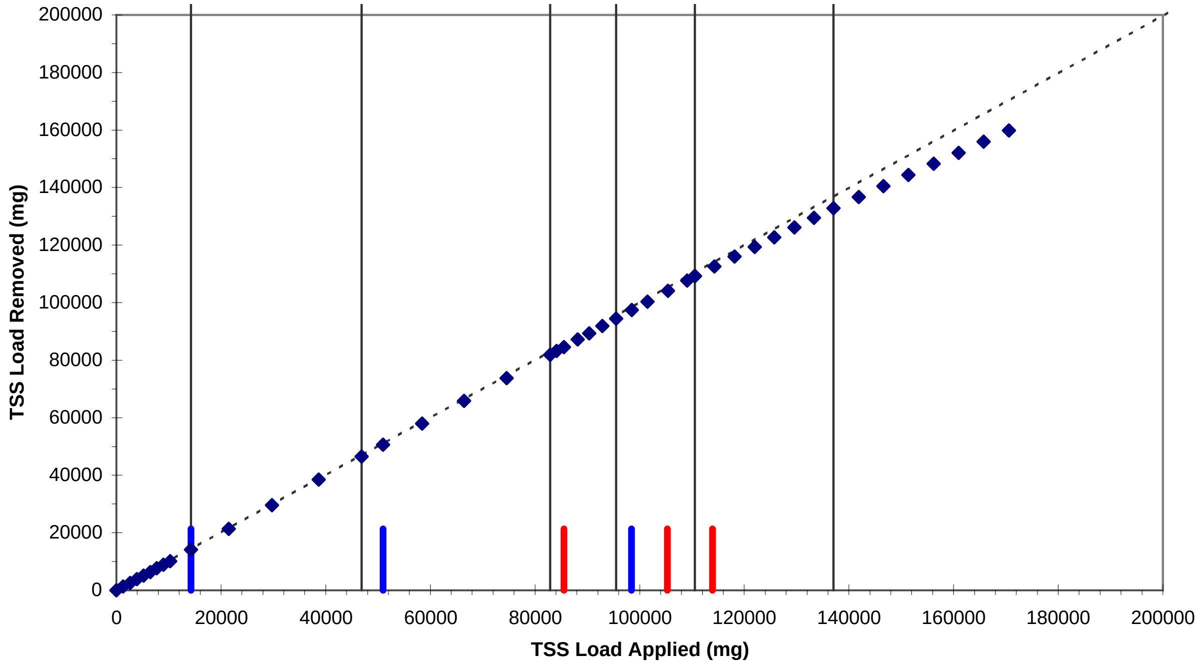
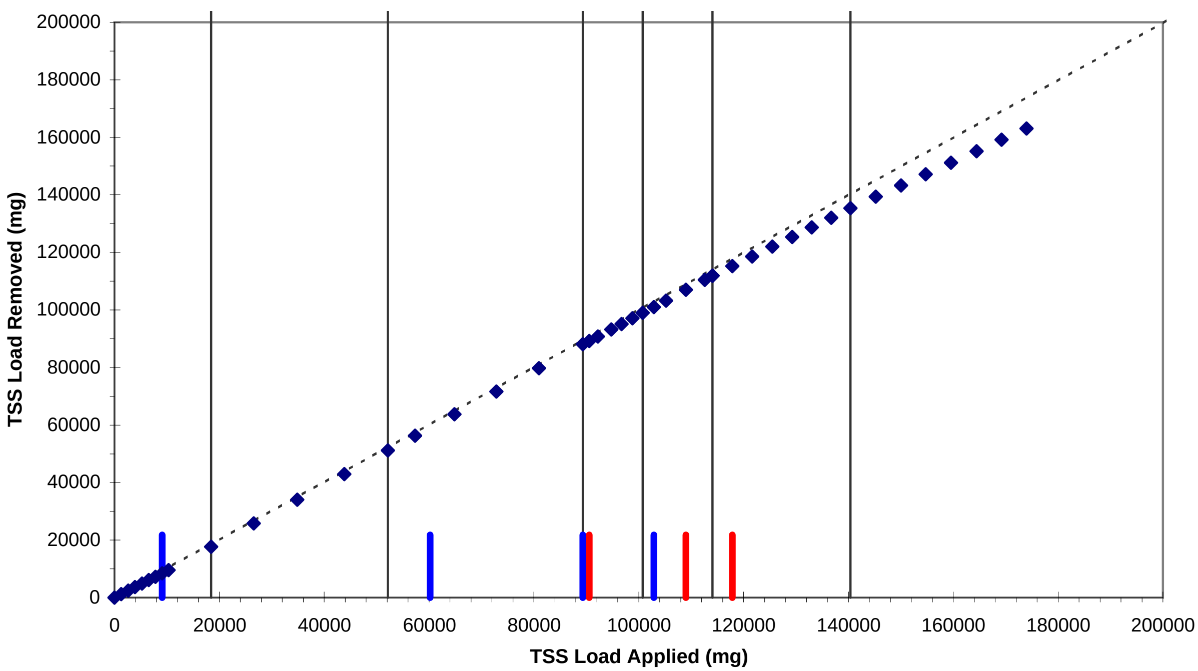
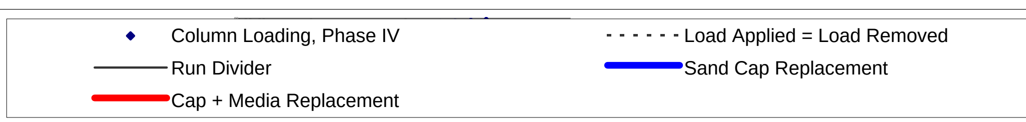


Figure C-228. TSS Load Removed vs Load Applied
Phase IV, Column 14 (Fe-Mod. Activated Alumina)





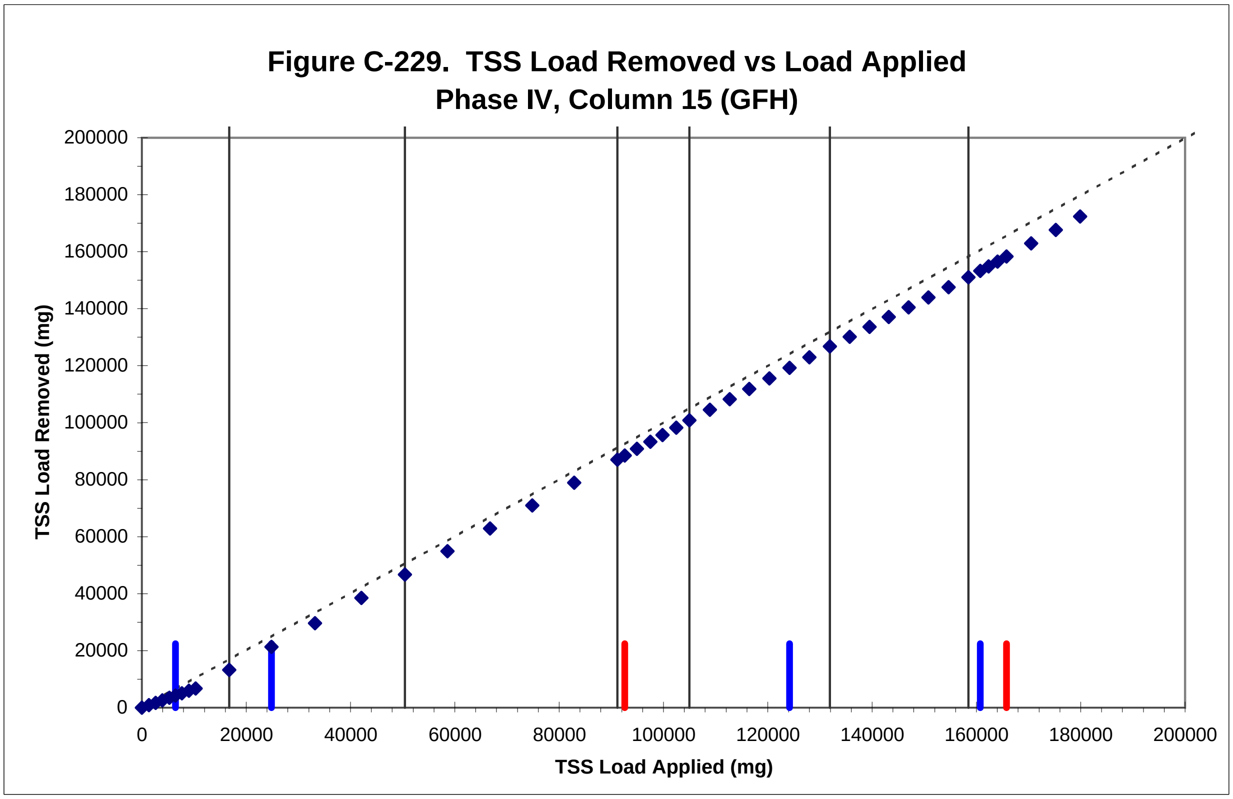


Figure C-229. TSS Load Removed vs Load Applied
Phase IV, Column 15 (GFH)
TSS Load Removed (mg)
TSS Load Applied (mg)
0
20000
40000
60000
80000
100000
120000
140000
160000
180000
200000

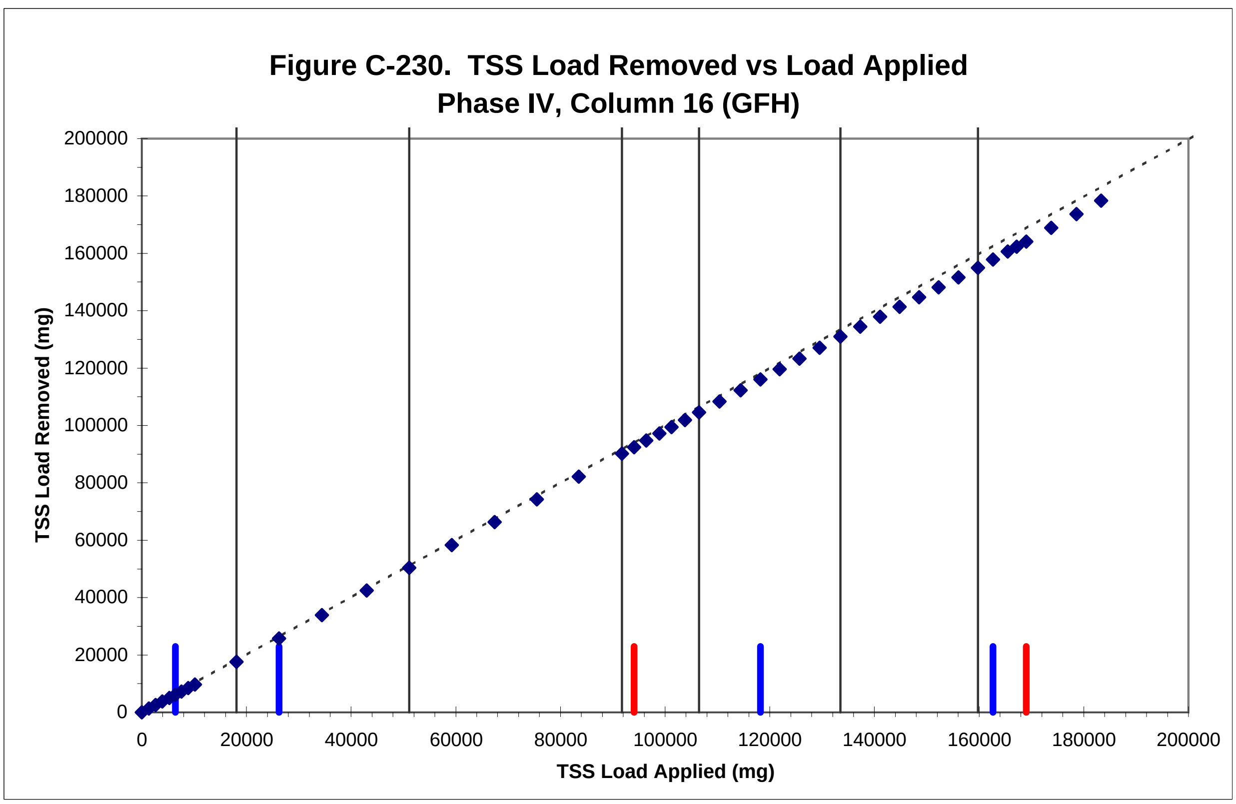
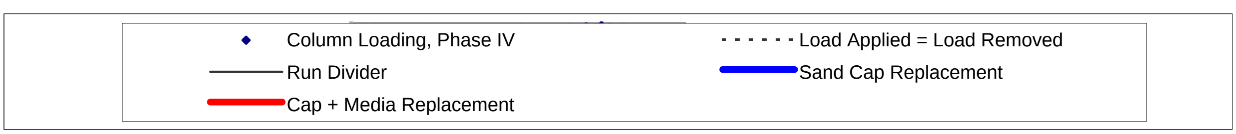


Figure C-230. TSS Load Removed vs Load Applied
Phase IV, Column 16 (GFH)
TSS Load Removed (mg)
TSS Load Applied (mg)
0
20000
40000
60000
80000
100000
120000
140000
160000
180000
200000


Column Loading, Phase IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

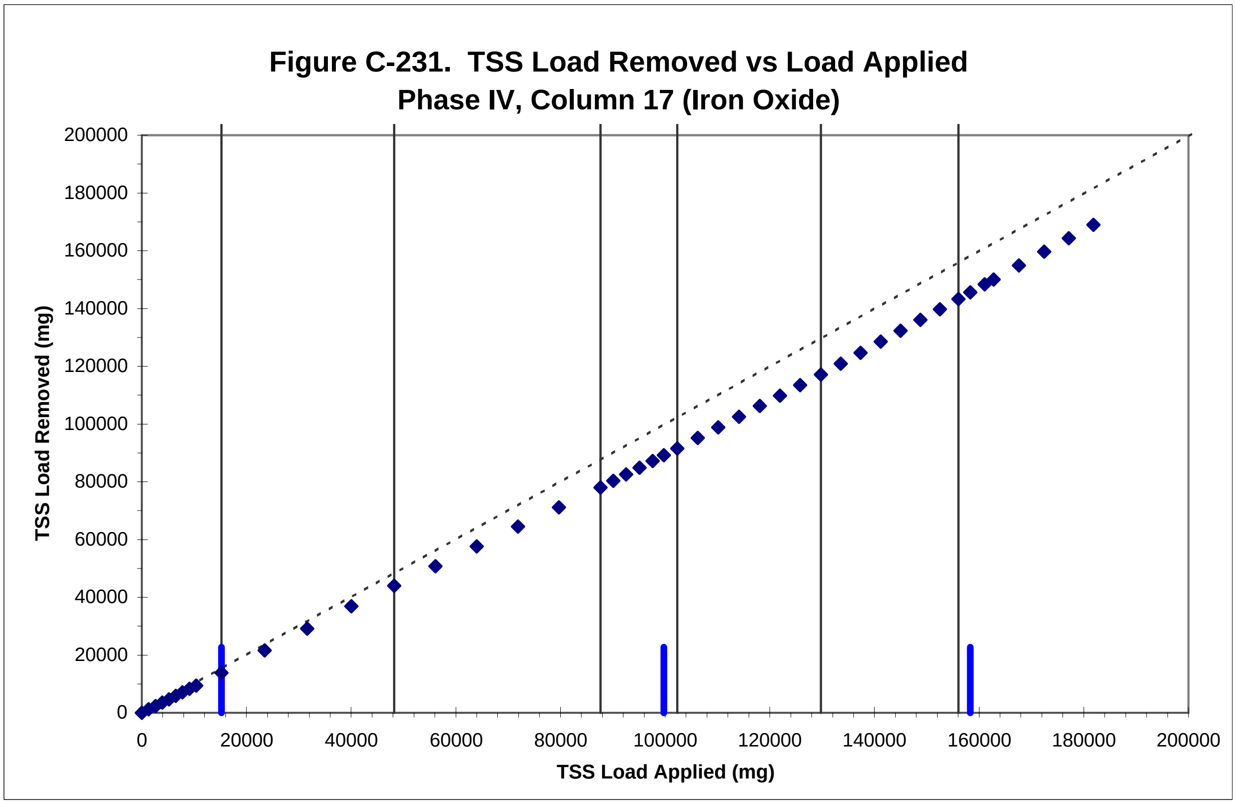


Figure C-231. TSS Load Removed vs Load Applied
Phase IV, Column 17 (Iron Oxide)
TSS Load Removed (mg)
TSS Load Applied (mg)
0
20000
40000
60000
80000
100000
120000
140000
160000
180000
200000

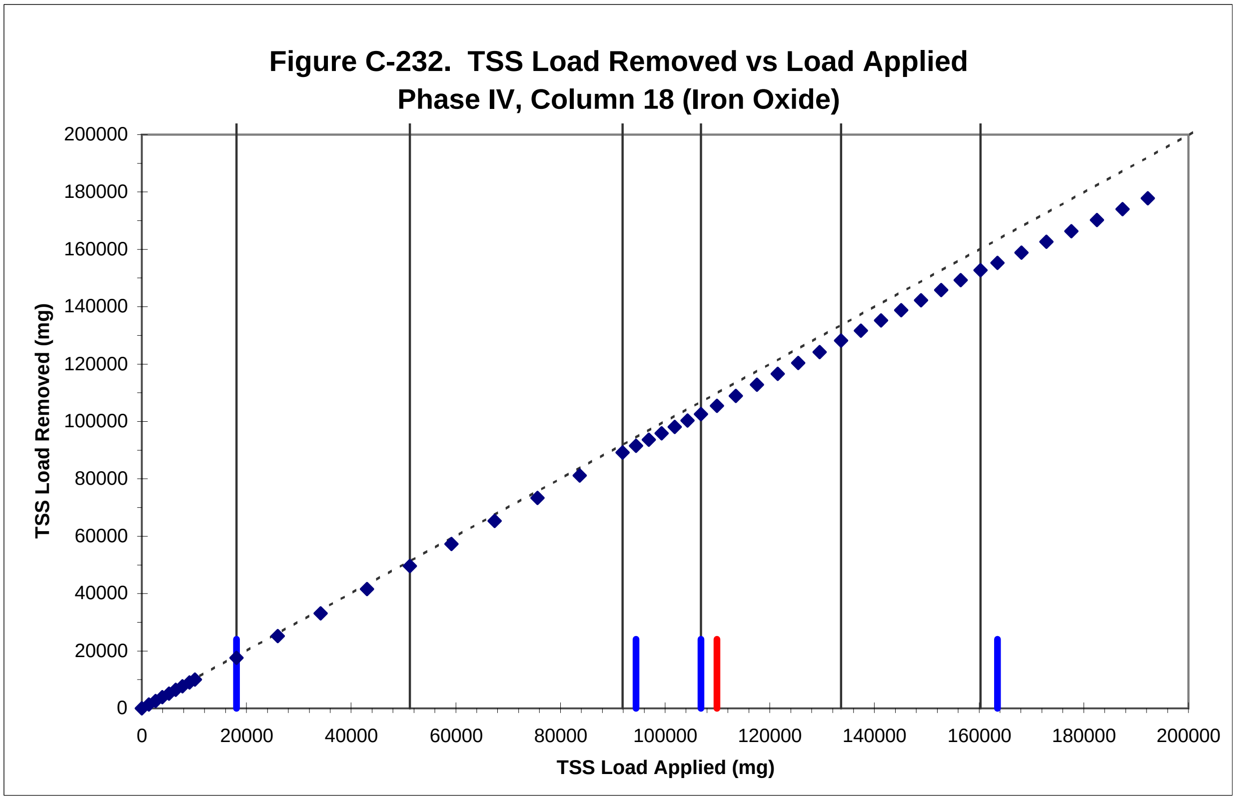
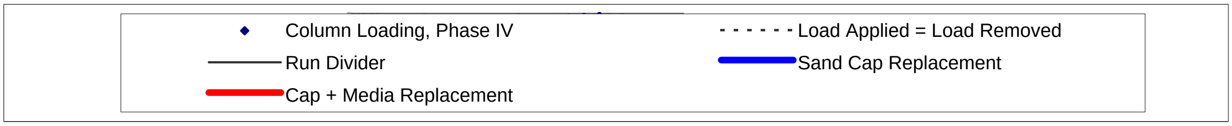


Figure C-232. TSS Load Removed vs Load Applied
Phase IV, Column 18 (Iron Oxide)
TSS Load Removed (mg)
TSS Load Applied (mg)
0
20000
40000
60000
80000
100000
120000
140000
160000
180000
200000


Column Loading, Phase IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

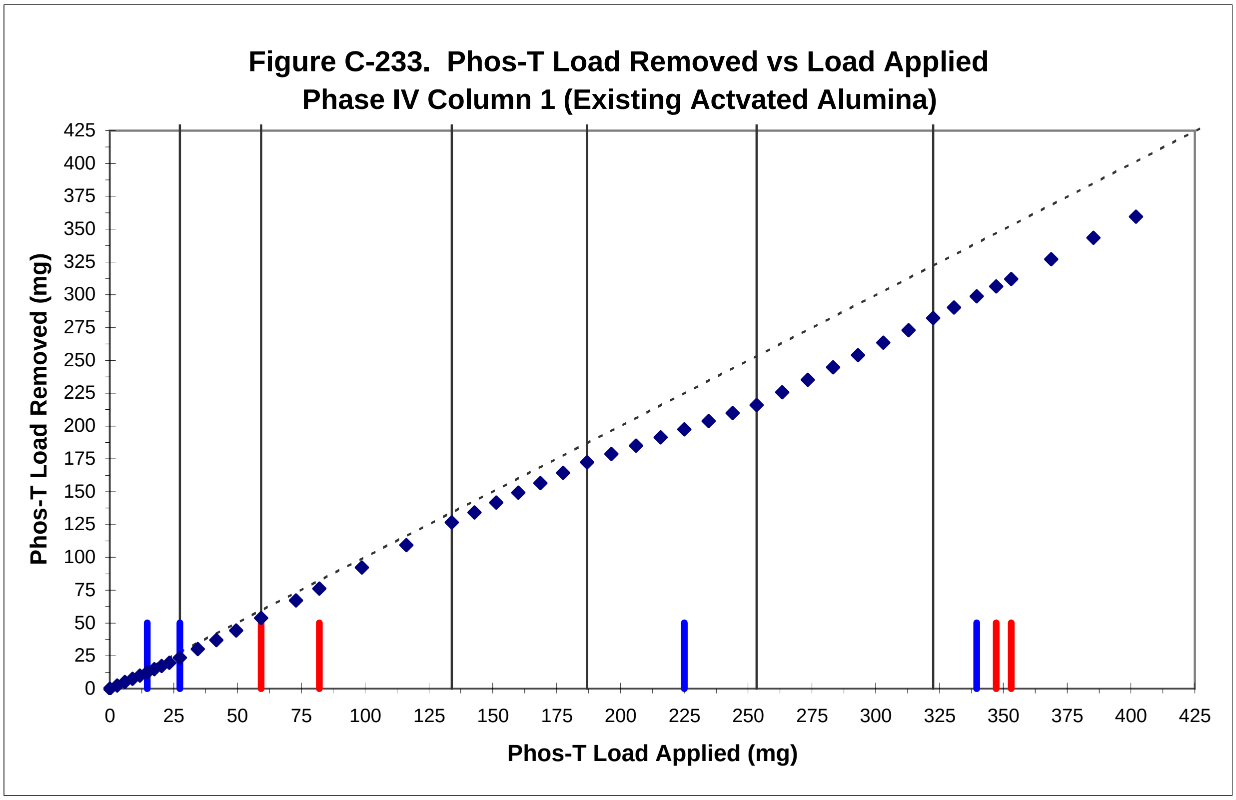


Figure C-233. Phos-T Load Removed vs Load Applied
Phase IV Column 1 (Existing Actvated Alumina)
Phos-T Load Removed (mg)
Phos-T Load Applied (mg)
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
375
400
425

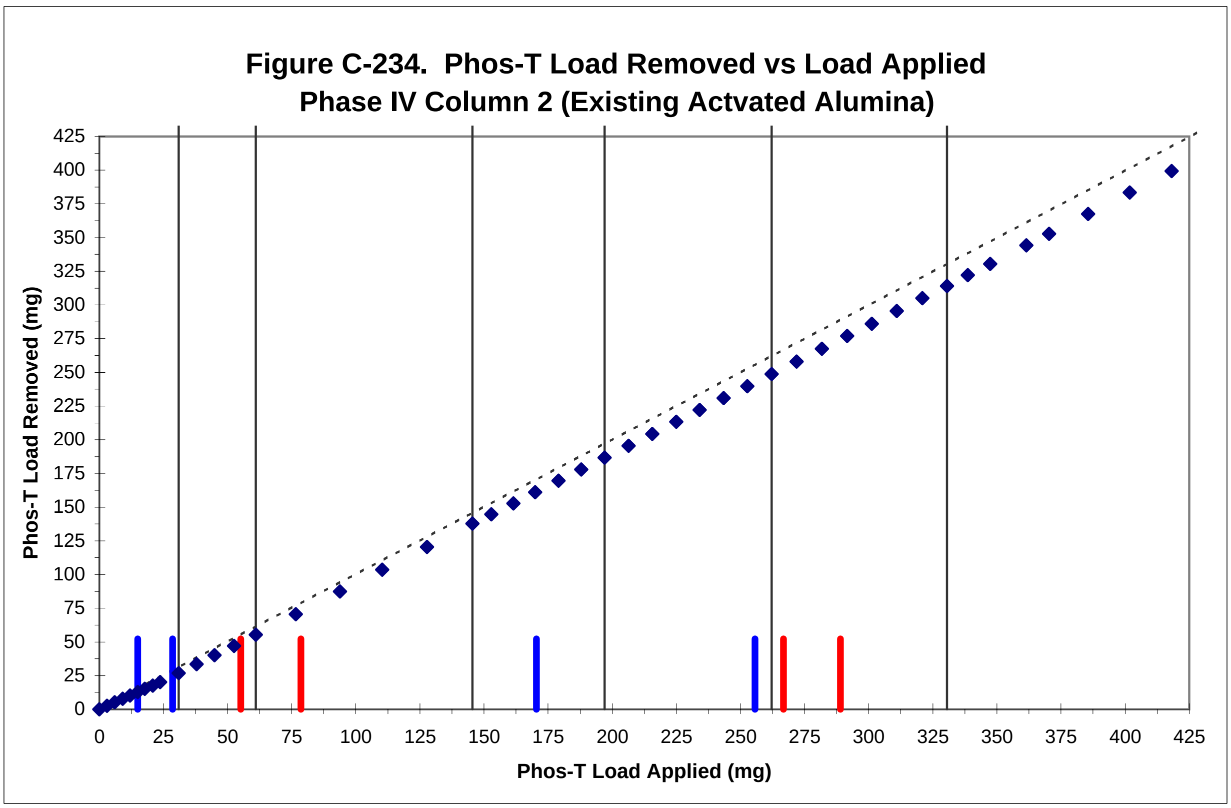
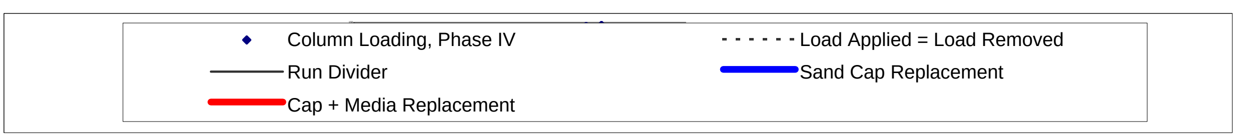


Figure C-234. Phos-T Load Removed vs Load Applied
Phase IV Column 2 (Existing Actvated Alumina)
Phos-T Load Removed (mg)
Phos-T Load Applied (mg)
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
375
400
425


Column Loading, Phase IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

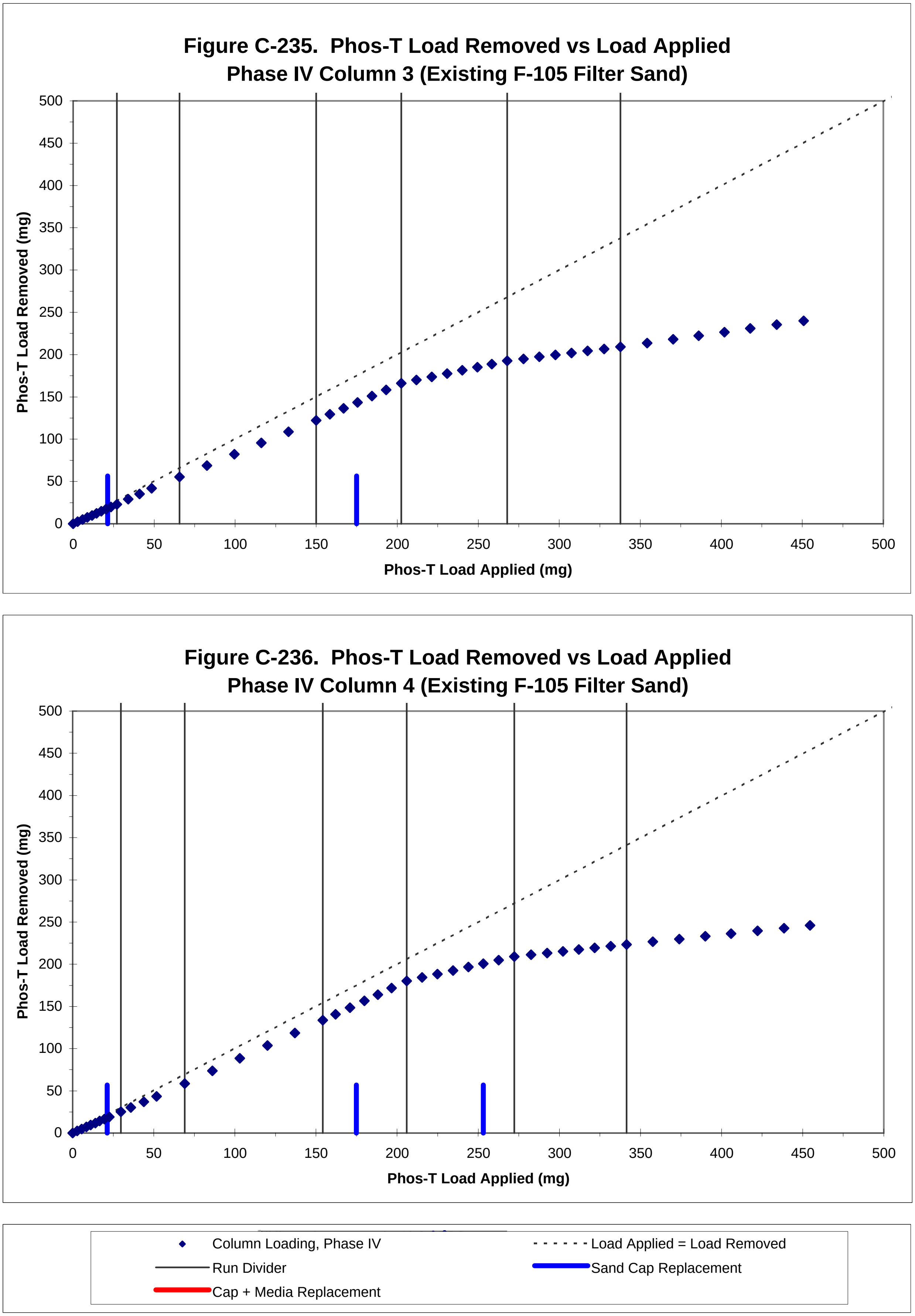


Figure C-235. Phos-T Load Removed vs Load Applied
Phase IV Column 3 (Existing F-105 Filter Sand)
Phos-T Load Removed (mg)
Phos-T Load Applied (mg)
0
50
100
150
200
250
300
350
400
450
500
Figure C-236. Phos-T Load Removed vs Load Applied
Phase IV Column 4 (Existing F-105 Filter Sand)
Phos-T Load Removed (mg)
Phos-T Load Applied (mg)
Column Loading, Phase IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

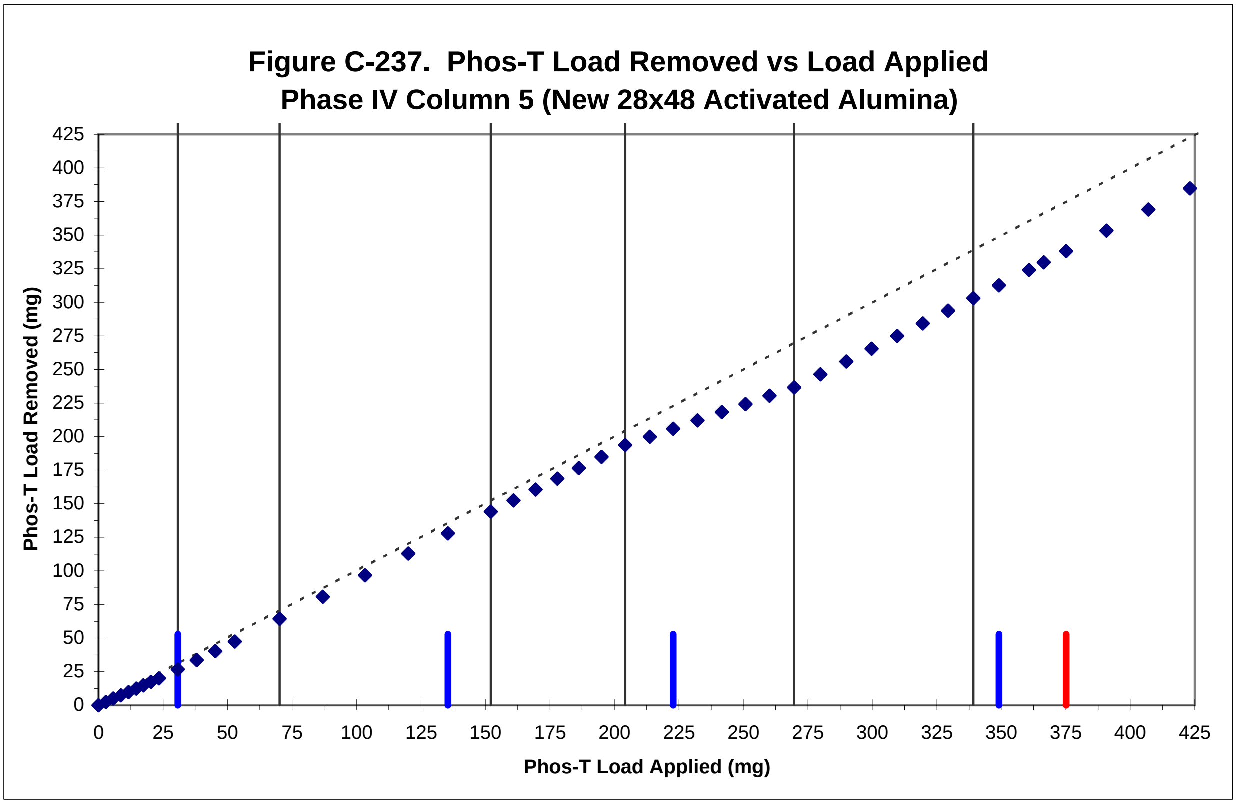


Figure C-237. Phos-T Load Removed vs Load Applied
Phase IV Column 5 (New 28x48 Activated Alumina)
Phos-T Load Removed (mg)
Phos-T Load Applied (mg)
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
375
400
425

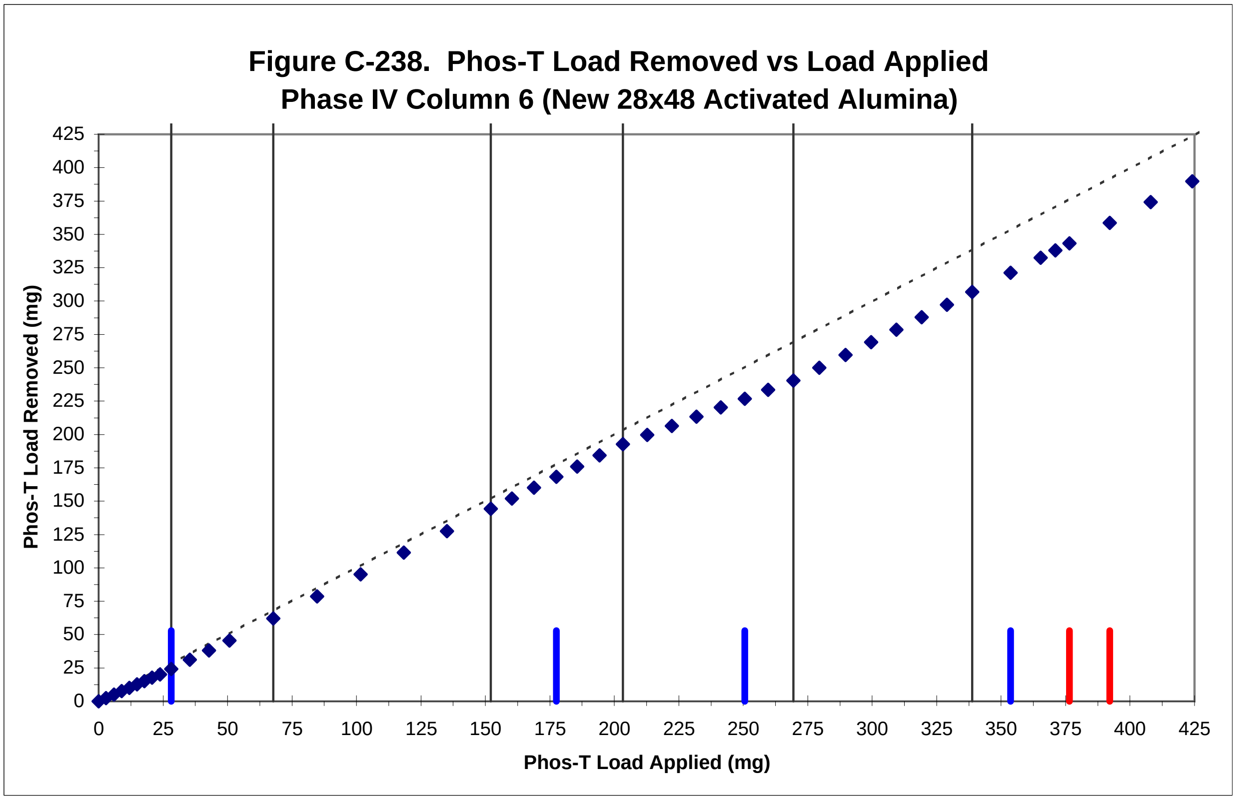
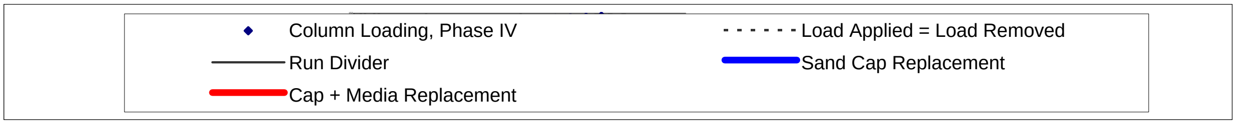


Figure C-238. Phos-T Load Removed vs Load Applied
Phase IV Column 6 (New 28x48 Activated Alumina)
Phos-T Load Removed (mg)
Phos-T Load Applied (mg)
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
375
400
425


Column Loading, Phase IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

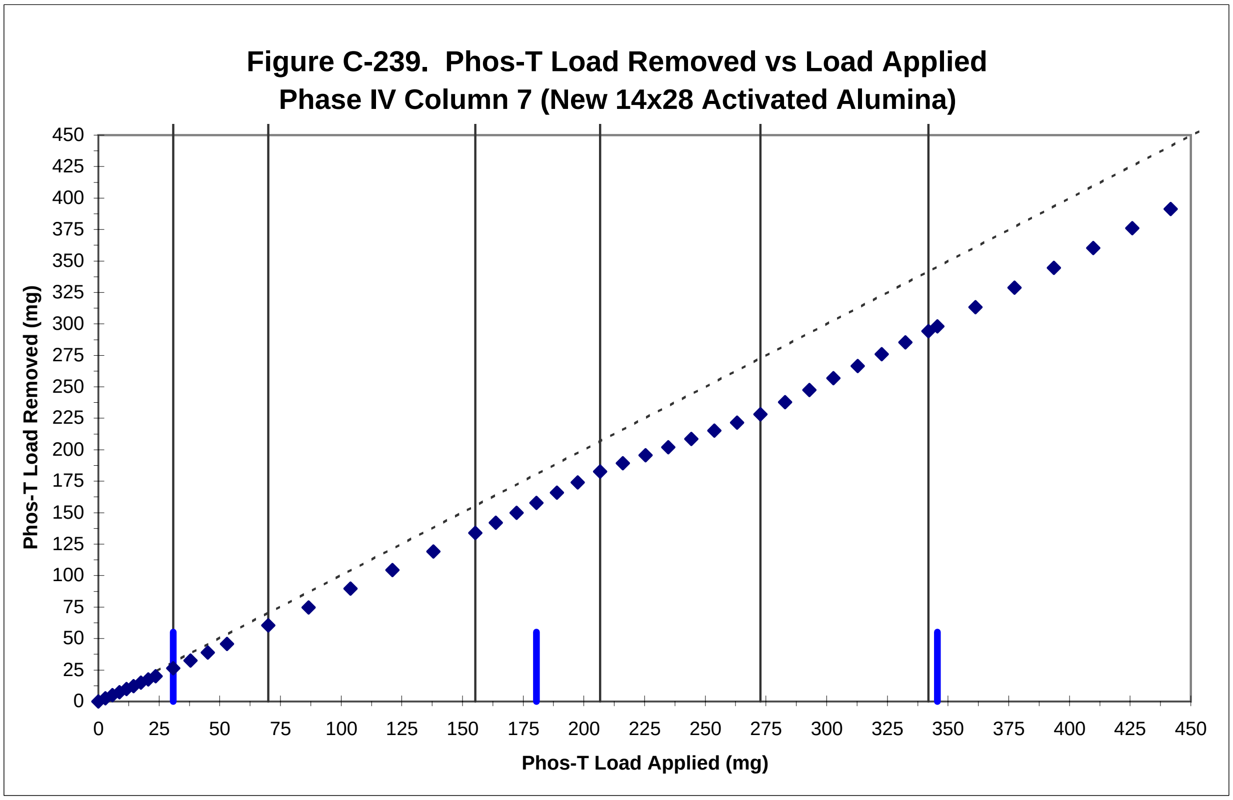


Figure C-239. Phos-T Load Removed vs Load Applied
Phase IV Column 7 (New 14x28 Activated Alumina)
Phos-T Load Removed (mg)
Phos-T Load Applied (mg)
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
375
400
425
450

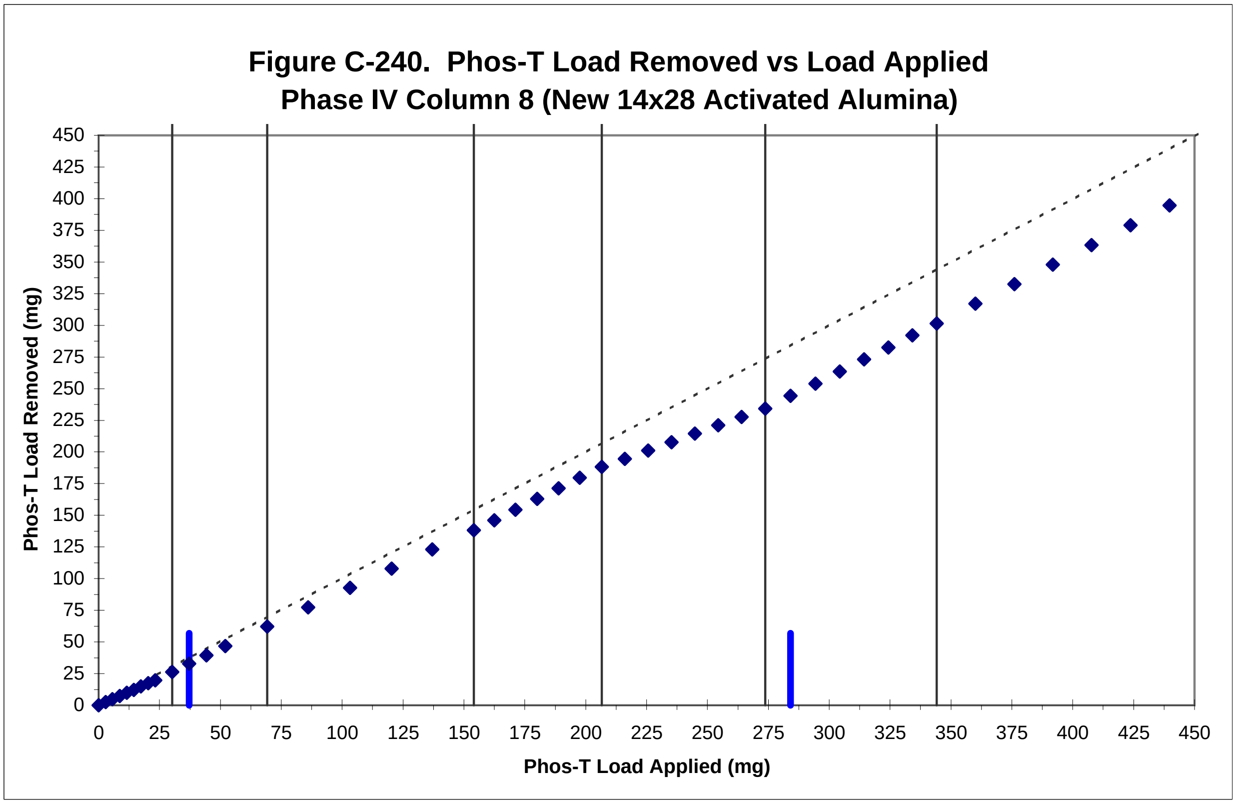


Figure C-240. Phos-T Load Removed vs Load Applied
Phase IV Column 8 (New 14x28 Activated Alumina)
Phos-T Load Removed (mg)
Phos-T Load Applied (mg)
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
375
400
425
450

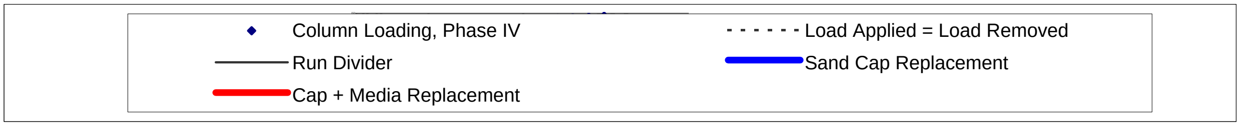

Column Loading, Phase IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

Figure C-241. Phos-T Load Removed vs Load Applied
Phase IV Column 9 (Superior 30 Sand)

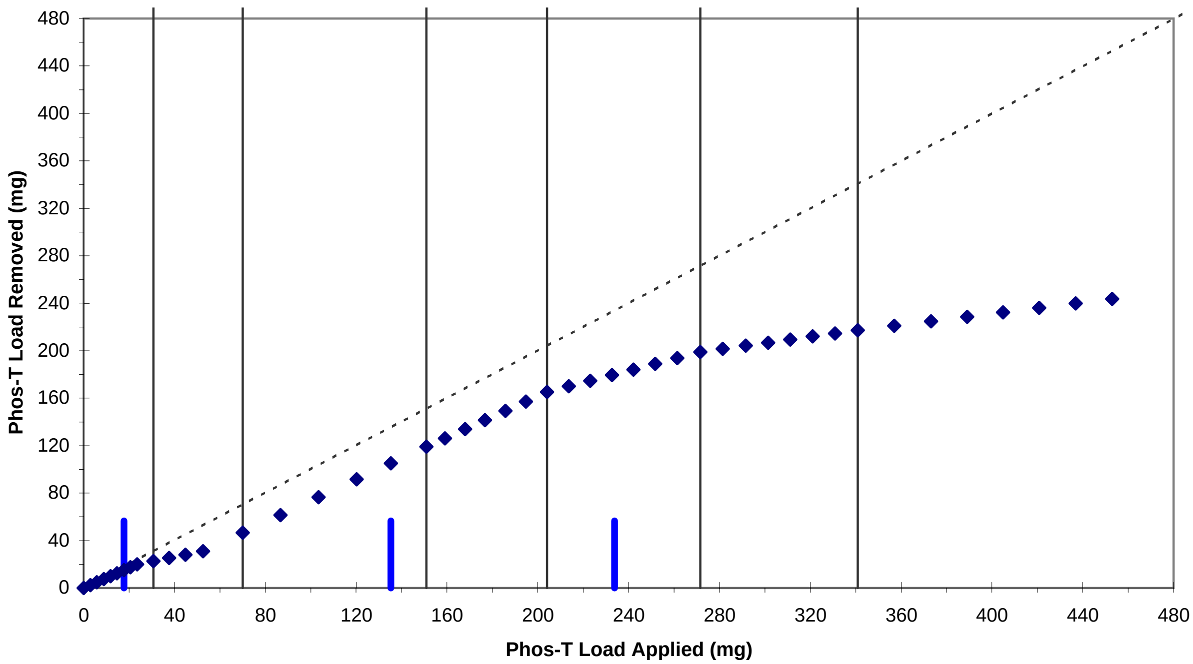
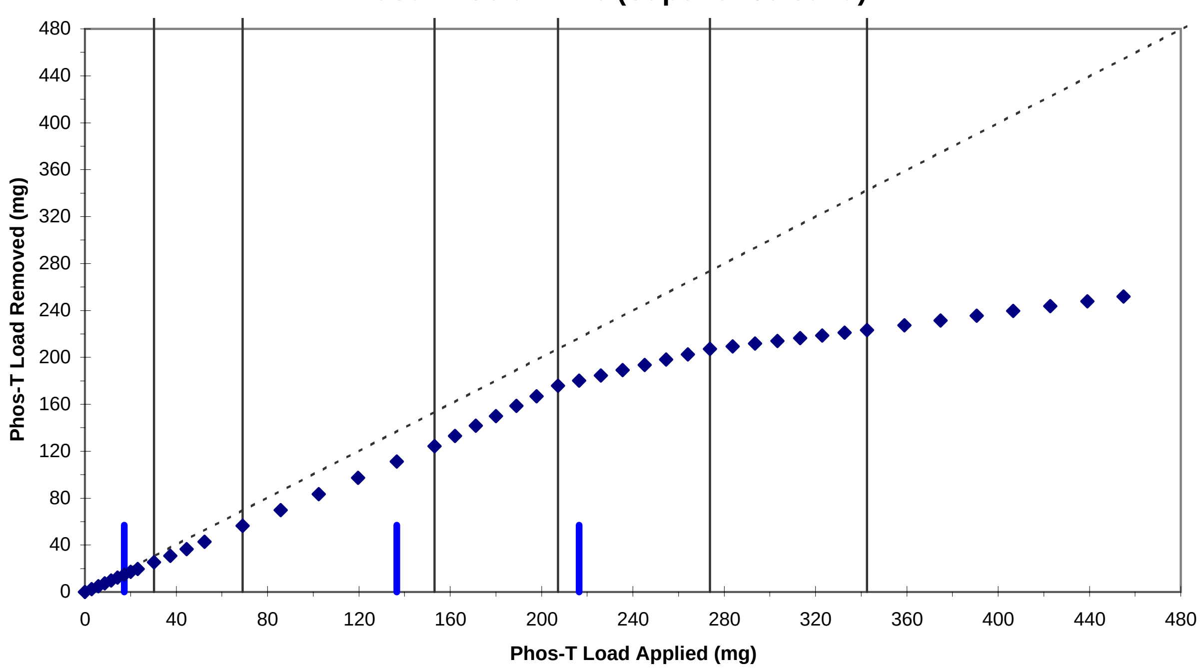
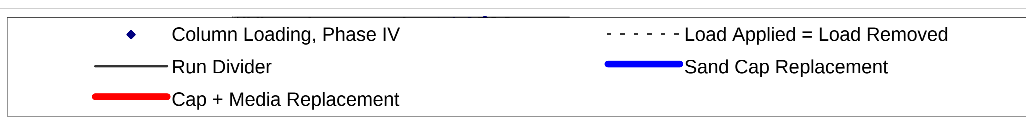


Figure C-242. Phos-T Load Removed vs Load Applied
Phase IV Column 10 (Superior 30 Sand)





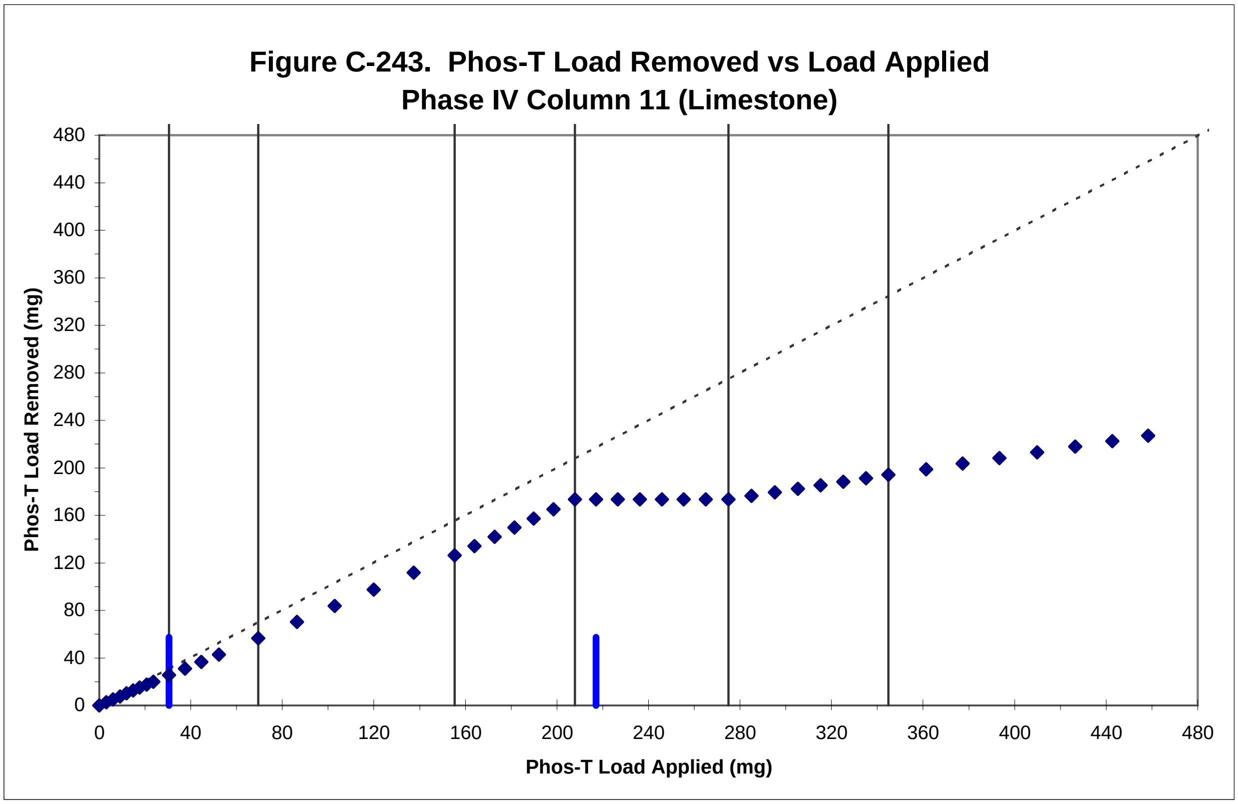


Figure C-243. Phos-T Load Removed vs Load Applied
Phase IV Column 11 (Limestone)
Phos-T Load Removed (mg)
Phos-T Load Applied (mg)
0
40
80
120
160
200
240
280
320
360
400
440
480

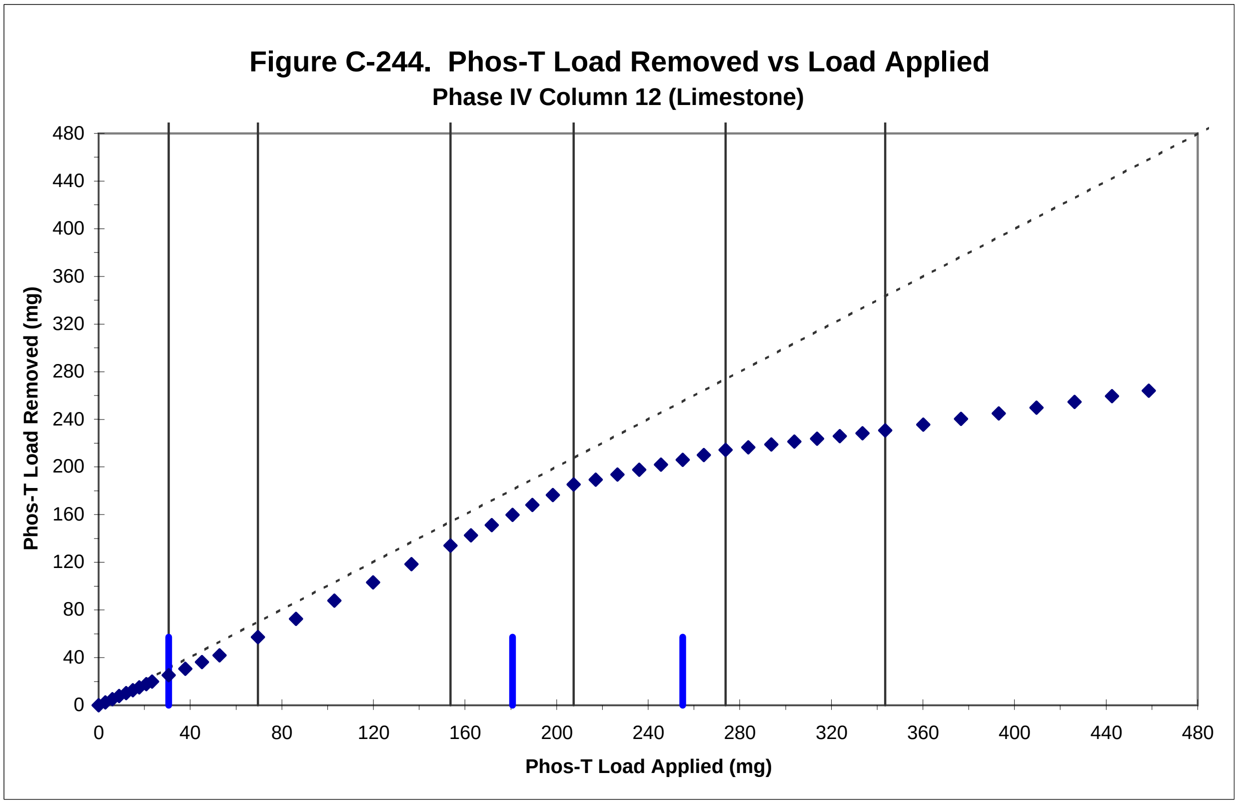


Figure C-244. Phos-T Load Removed vs Load Applied
Phase IV Column 12 (Limestone)
Phos-T Load Removed (mg)
Phos-T Load Applied (mg)
0
40
80
120
160
200
240
280
320
360
400
440
480

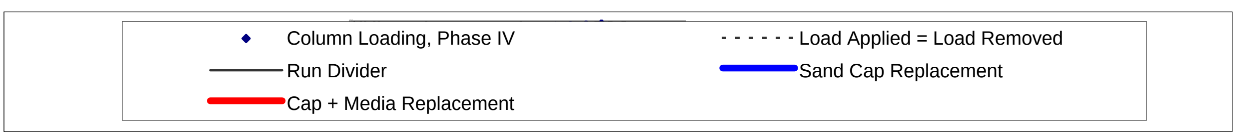

Column Loading, Phase IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

Figure C-245. Phos-T Load Removed vs Load Applied
Phase IV Column 13 (Fe-Mod. Activated Alumina)

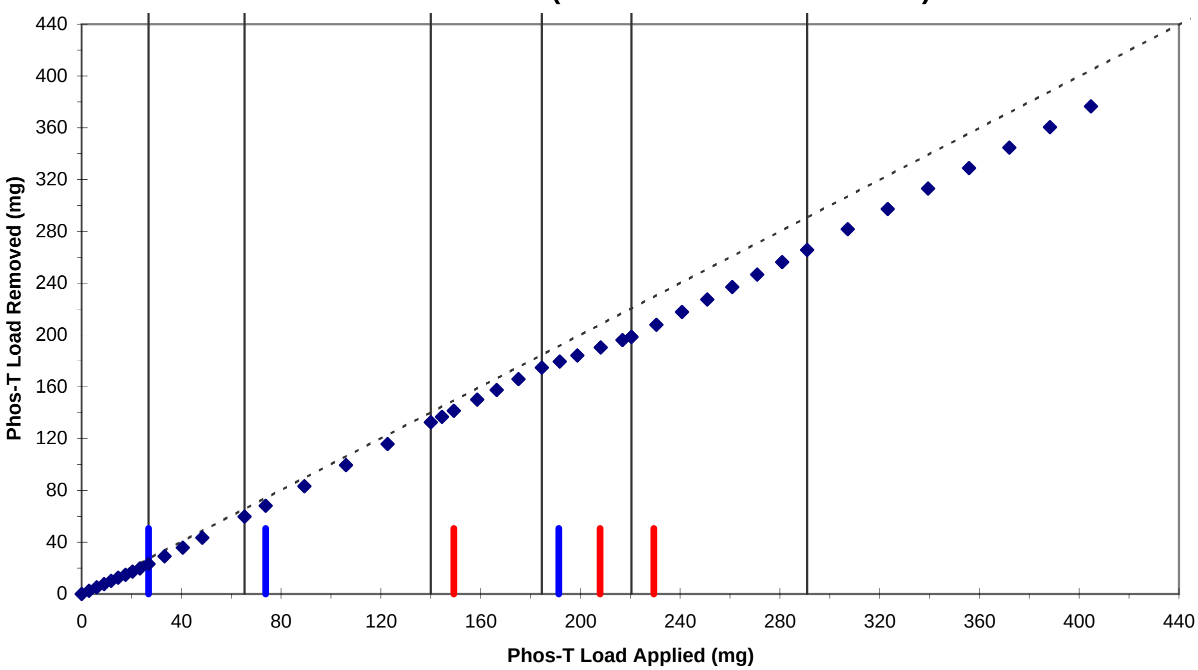
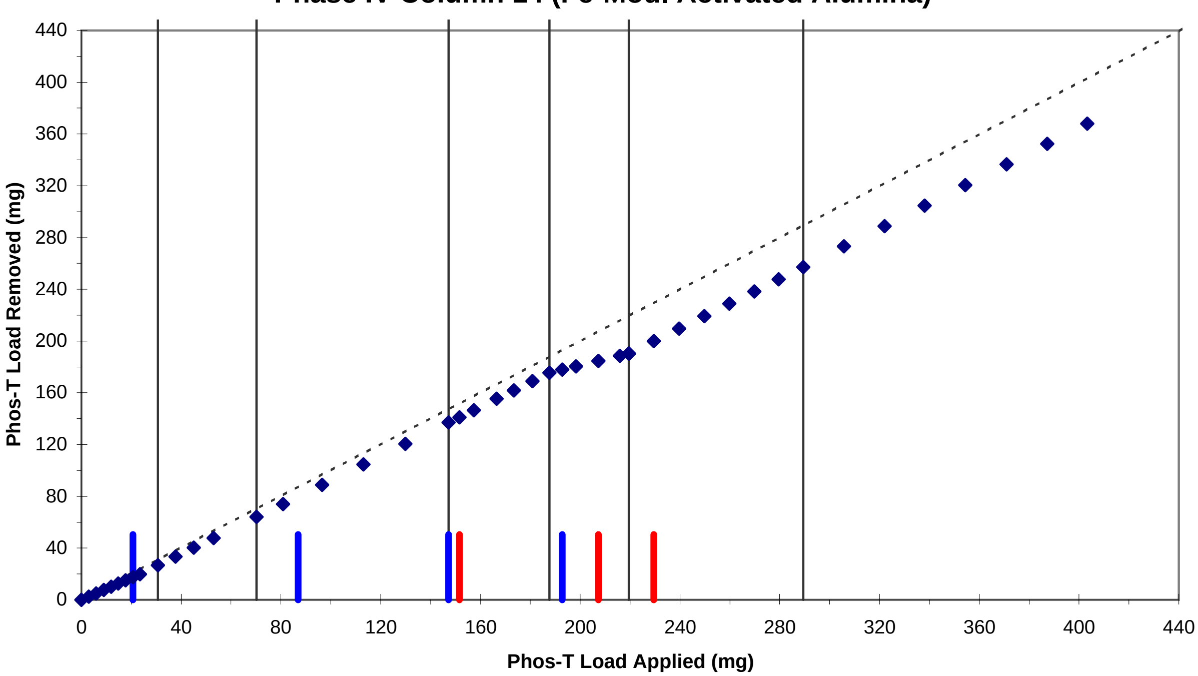
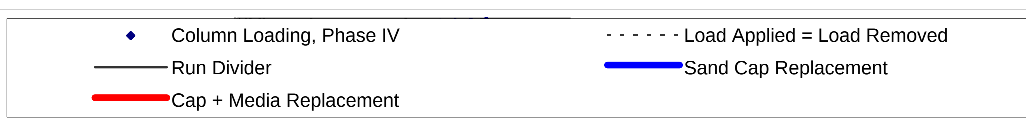


Figure C-246. Phos-T Load Removed vs Load Applied
Phase IV Column 14 (Fe-Mod. Activated Alumina)





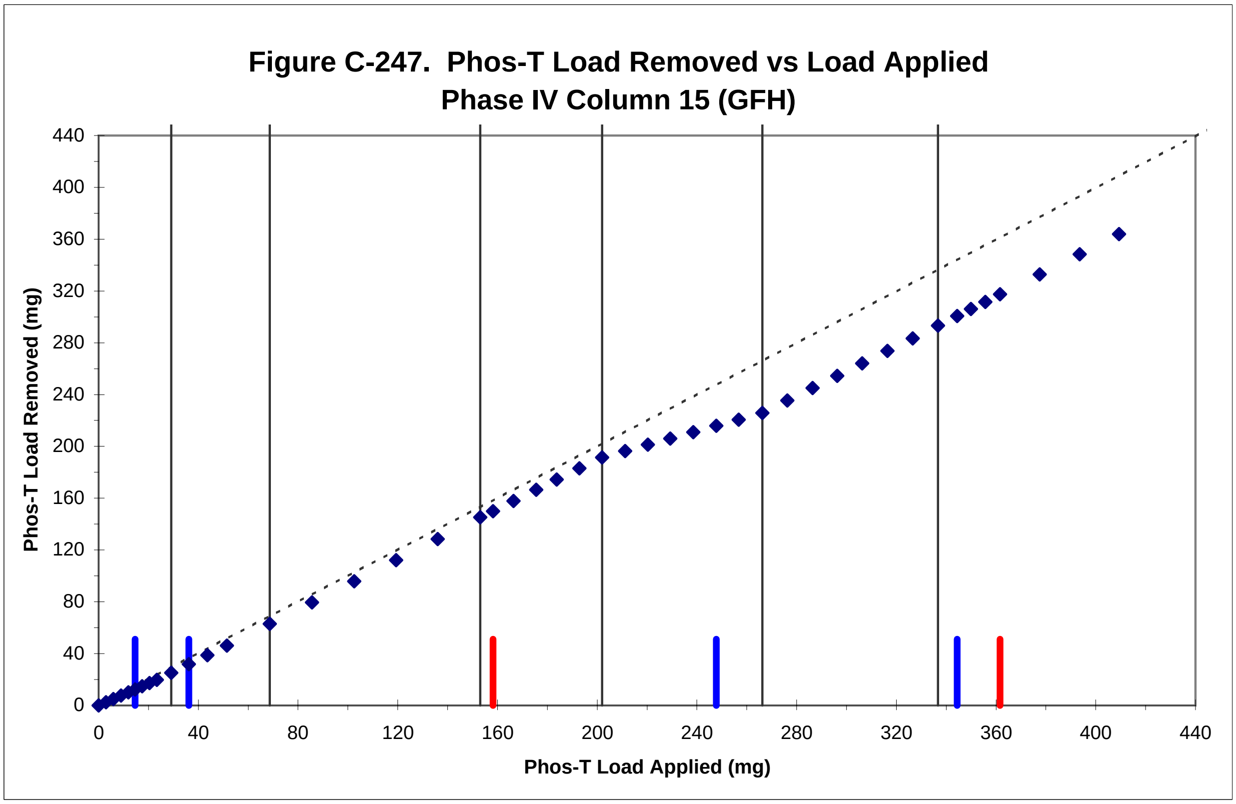


Figure C-247. Phos-T Load Removed vs Load Applied
Phase IV Column 15 (GFH)
Phos-T Load Removed (mg)
0
40
80
120
160
200
240
280
320
360
400
440
Phos-T Load Applied (mg)
0
40
80
120
160
200
240
280
320
360
400
440

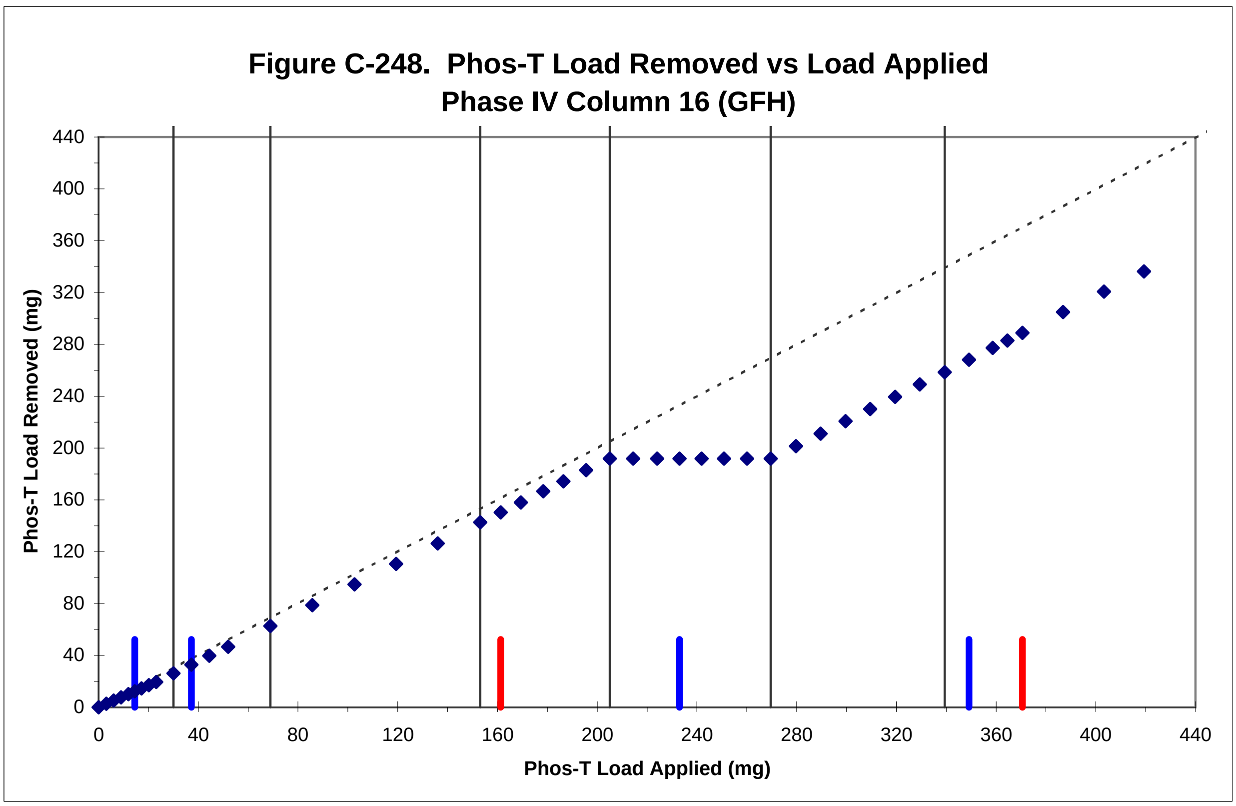
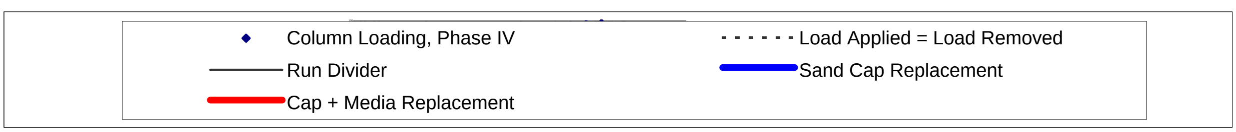


Figure C-248. Phos-T Load Removed vs Load Applied
Phase IV Column 16 (GFH)
Phos-T Load Removed (mg)
0
40
80
120
160
200
240
280
320
360
400
440
Phos-T Load Applied (mg)
0
40
80
120
160
200
240
280
320
360
400
440


Column Loading, Phase IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

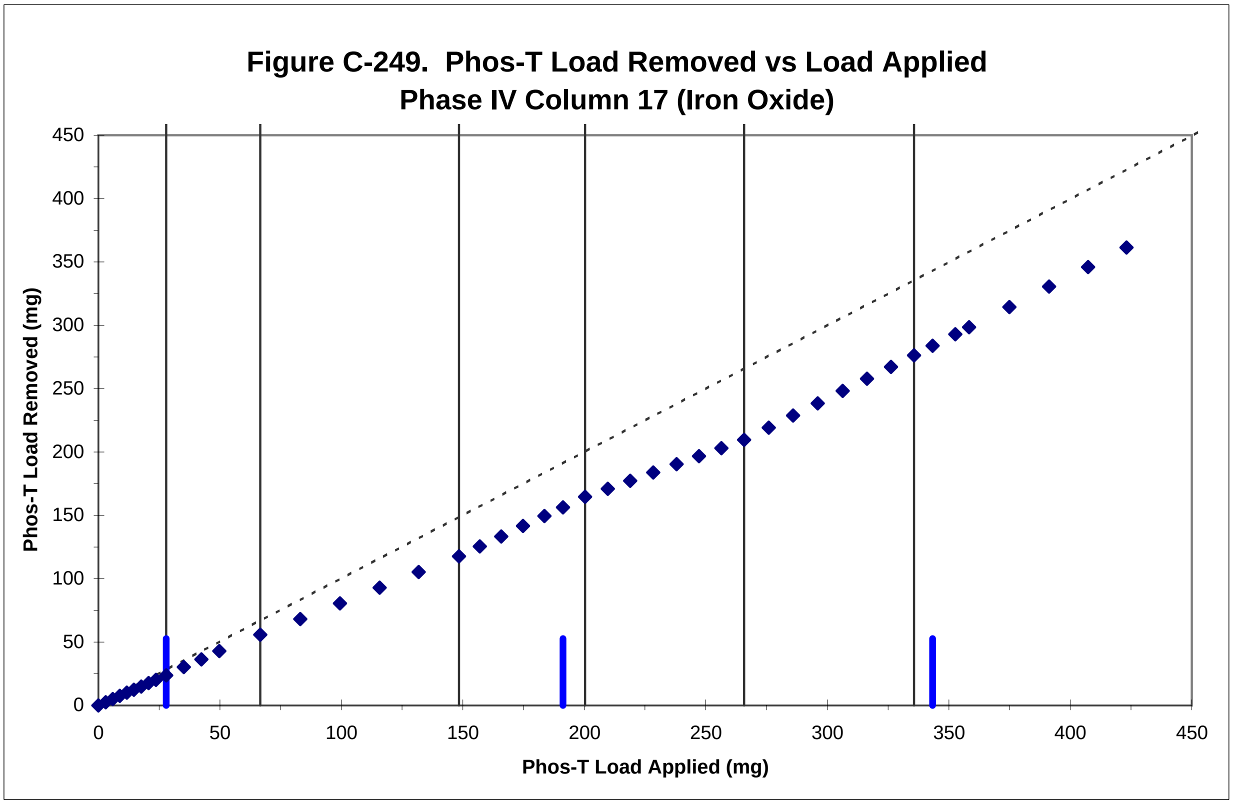


Figure C-249. Phos-T Load Removed vs Load Applied
Phase IV Column 17 (Iron Oxide)
Phos-T Load Removed (mg)
Phos-T Load Applied (mg)
0
50
100
150
200
250
300
350
400
450

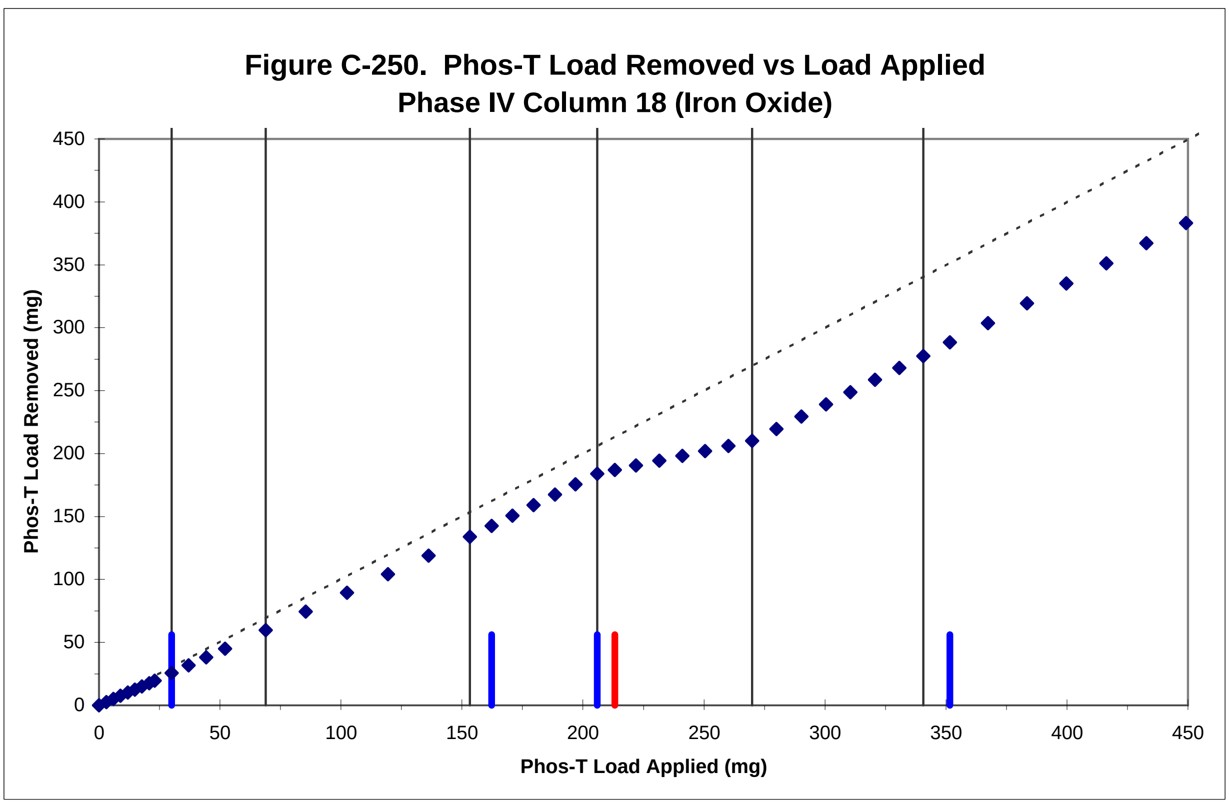


Figure C-250. Phos-T Load Removed vs Load Applied
Phase IV Column 18 (Iron Oxide)
Phos-T Load Removed (mg)
Phos-T Load Applied (mg)
0
50
100
150
200
250
300
350
400
450

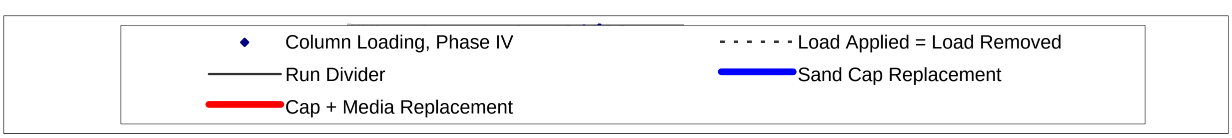

Column Loading, Phase IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

Figure C-251. Phos-D Load Removed vs Load Applied
Phase IV, Column 1 (Existing Actvated Alumina)

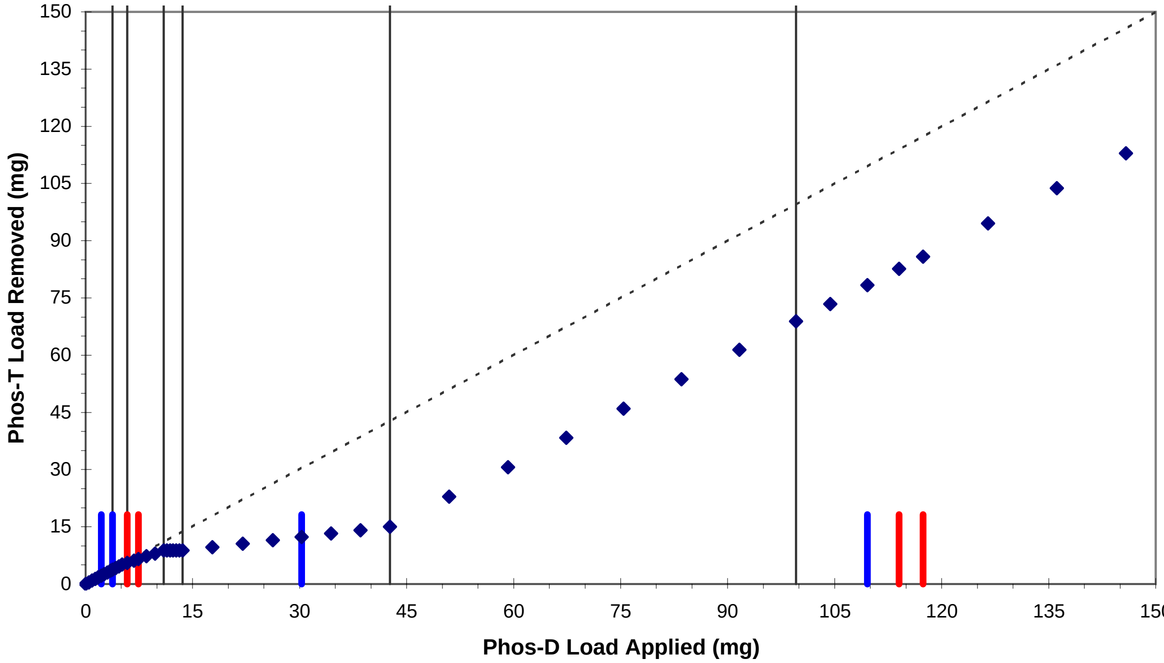
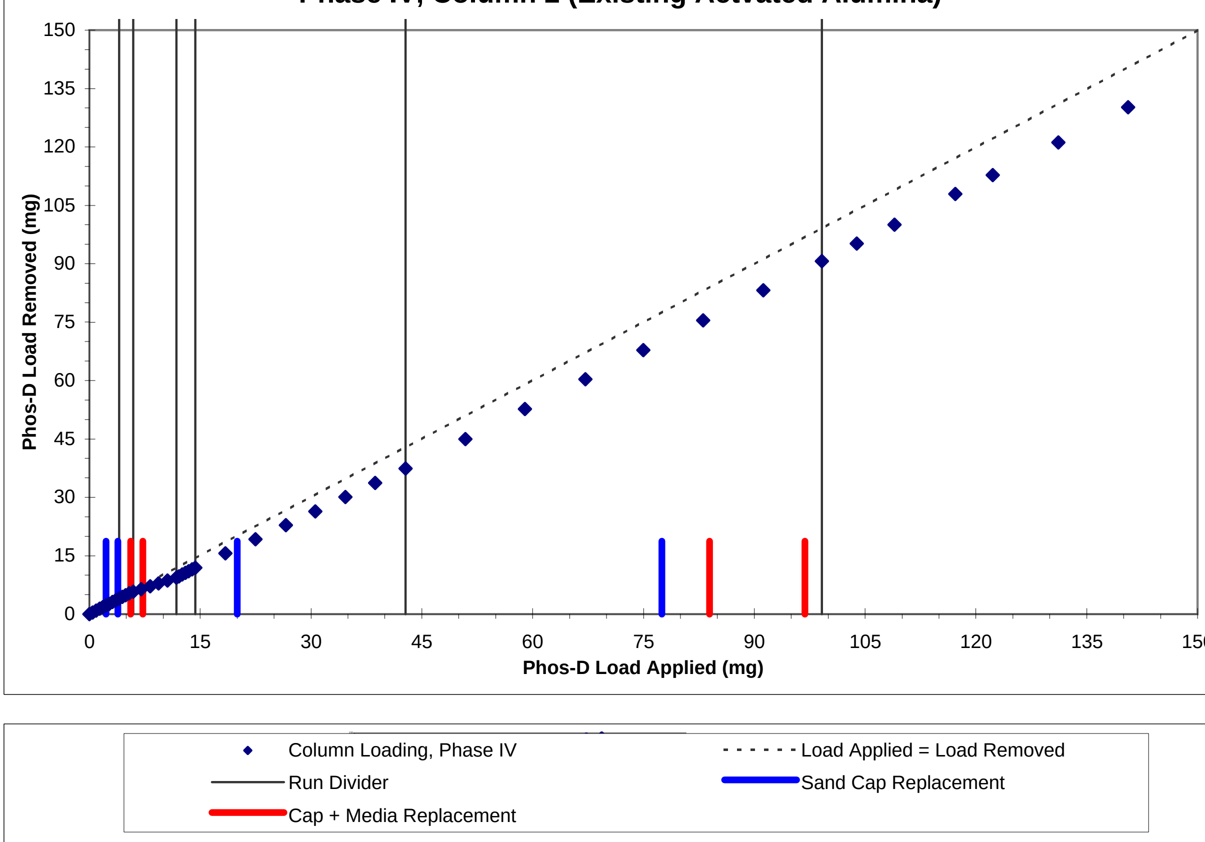


Figure C-252. Phos-D Load Removed vs Load Applied
Phase IV, Column 2 (Existing Actvated Alumina)



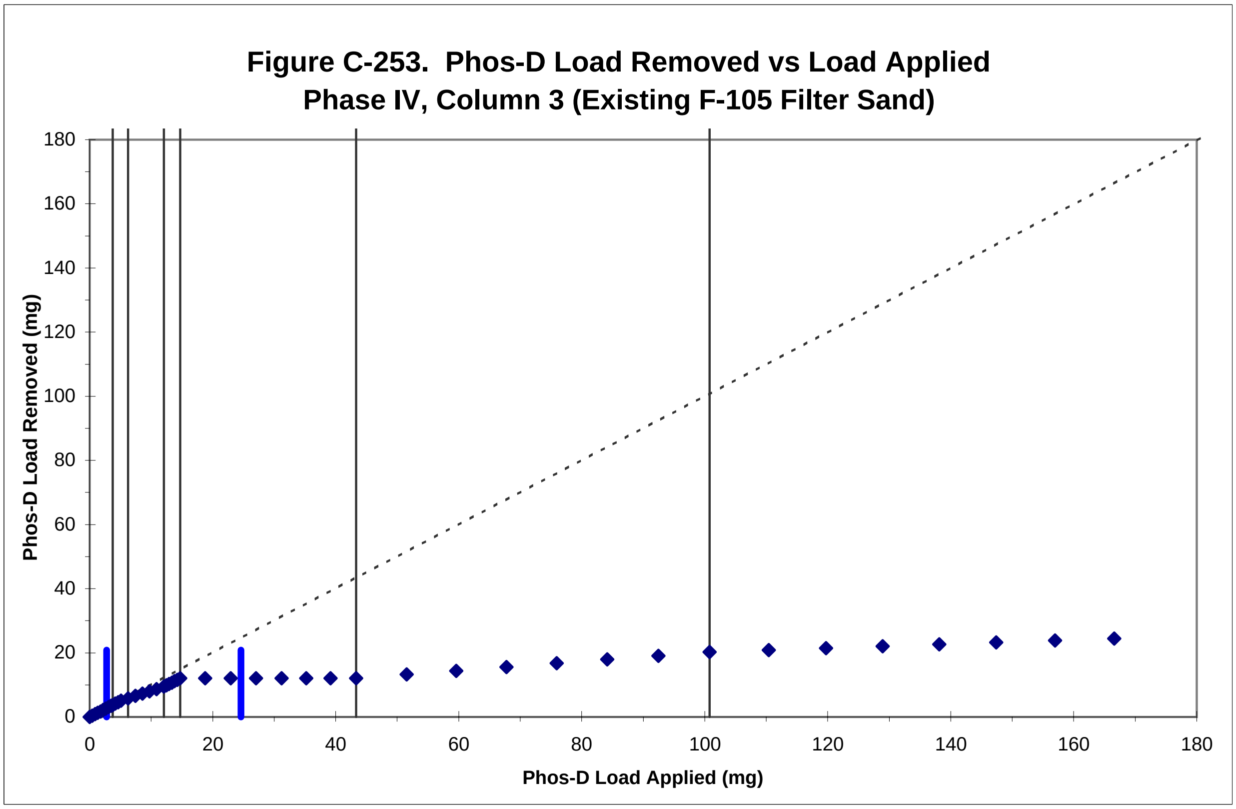


Figure C-253. Phos-D Load Removed vs Load Applied
Phase IV, Column 3 (Existing F-105 Filter Sand)
Phos-D Load Removed (mg)
Phos-D Load Applied (mg)
0
20
40
60
80
100
120
140
160
180

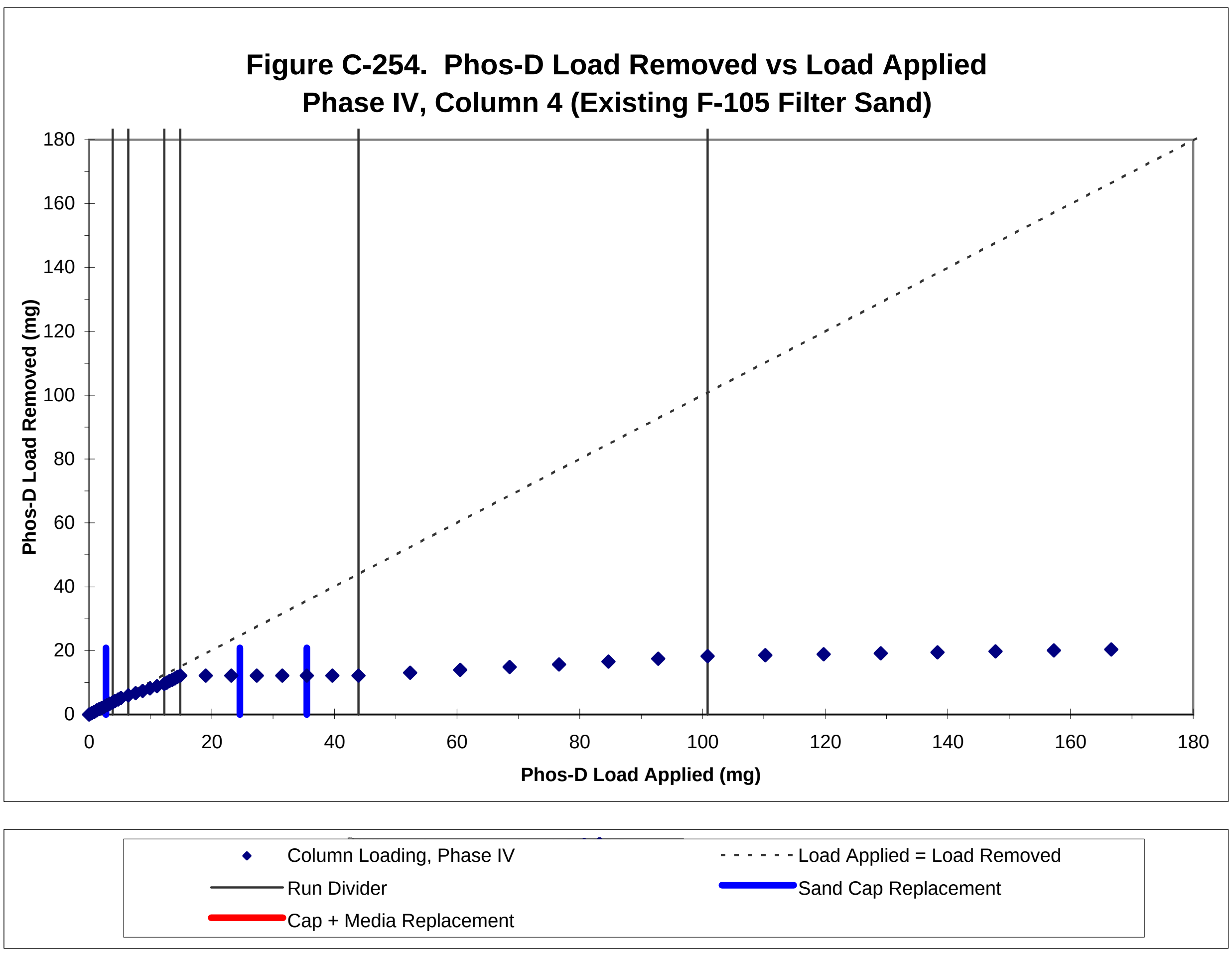


Figure C-254. Phos-D Load Removed vs Load Applied
Phase IV, Column 4 (Existing F-105 Filter Sand)
Phos-D Load Removed (mg)
Phos-D Load Applied (mg)
0
20
40
60
80
100
120
140
160
180
Column Loading, Phase IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

Figure C-255. Phos-D Load Removed vs Load Applied
Phase IV, Column 5 (New 28x48 Activated Alumina)

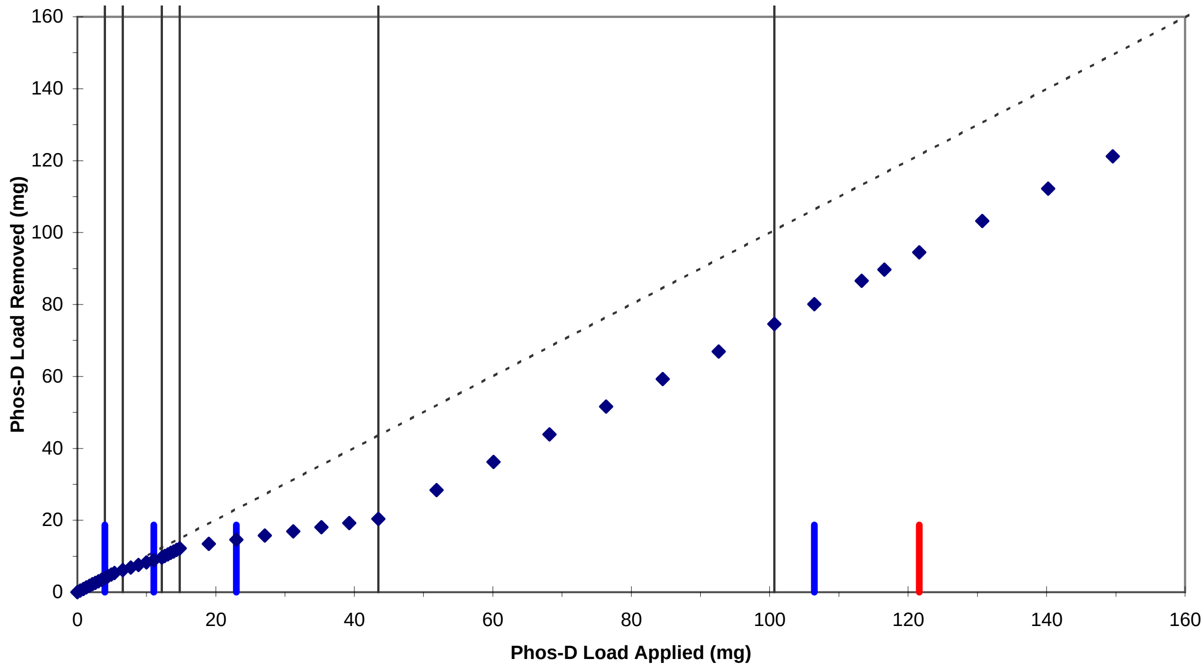
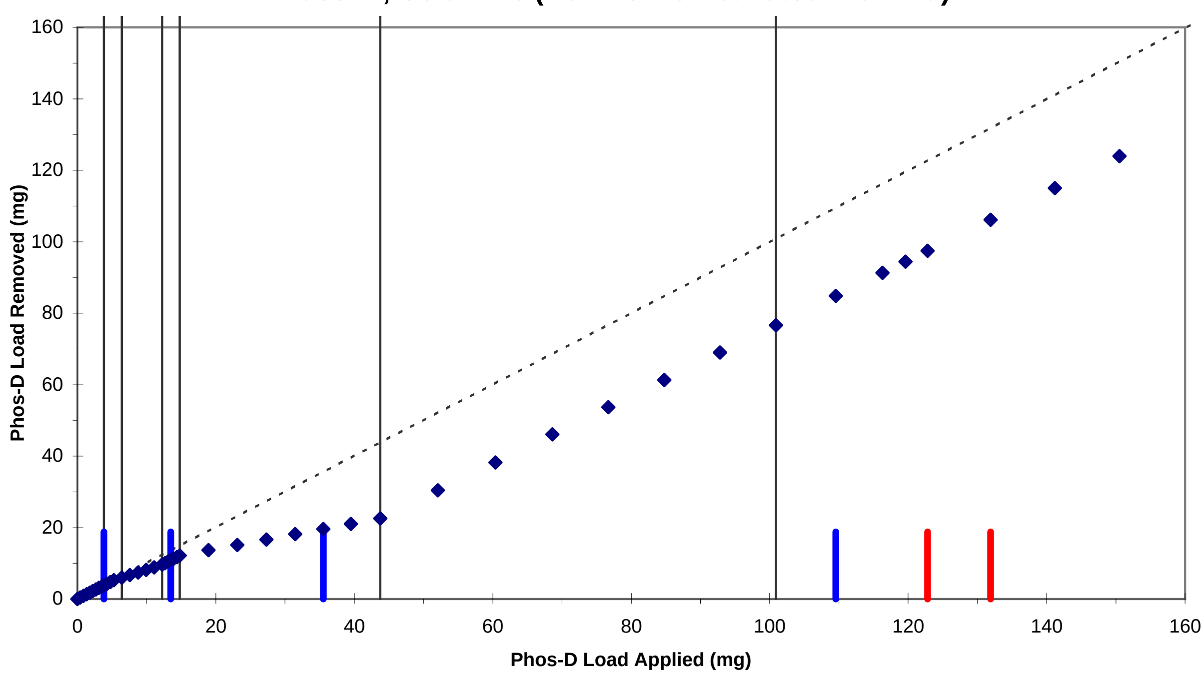
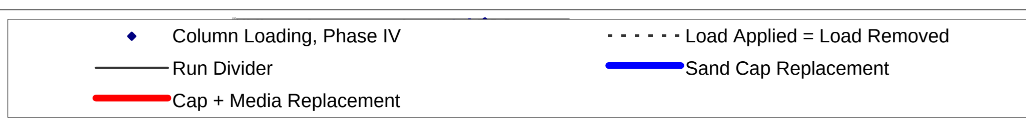


Figure C-256. Phos-D Load Removed vs Load Applied
Phase IV, Column 6 (New 28x48 Activated Alumina)





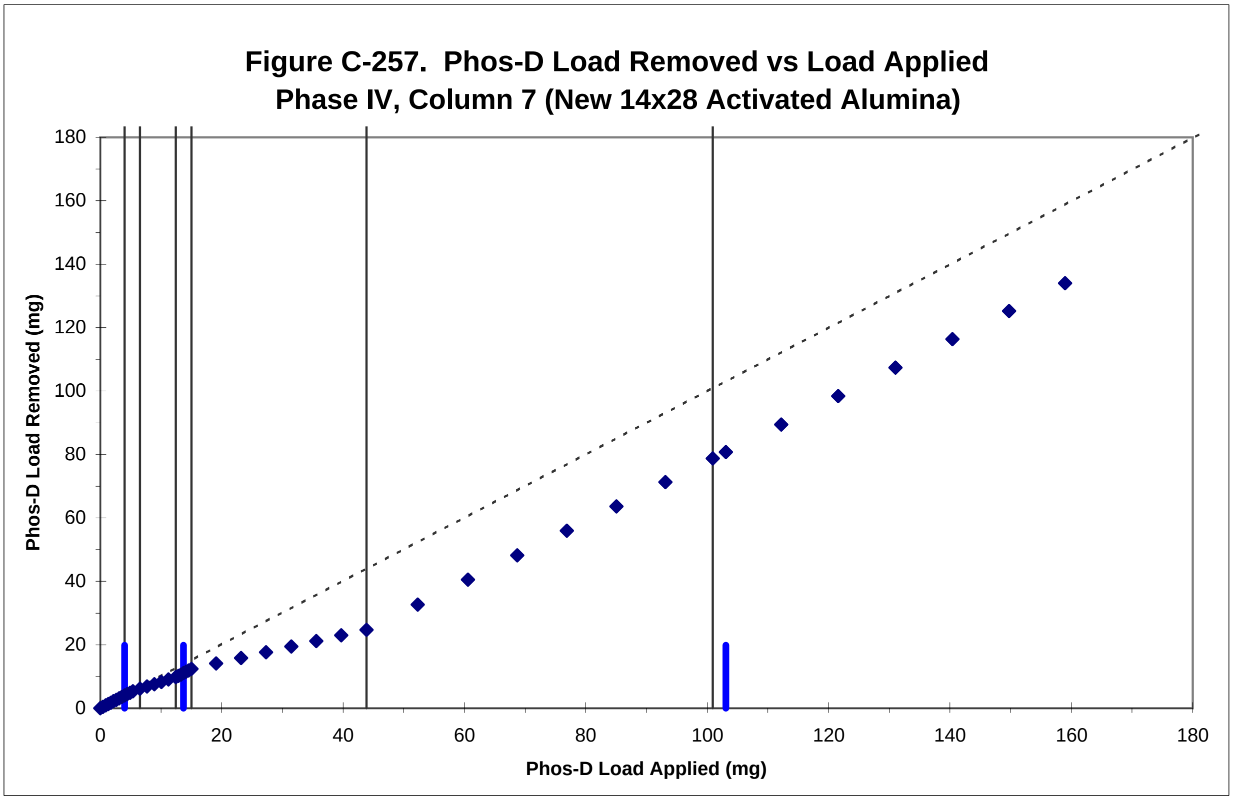


Figure C-257. Phos-D Load Removed vs Load Applied
Phase IV, Column 7 (New 14x28 Activated Alumina)
Phos-D Load Removed (mg)
Phos-D Load Applied (mg)
0
20
40
60
80
100
120
140
160
180

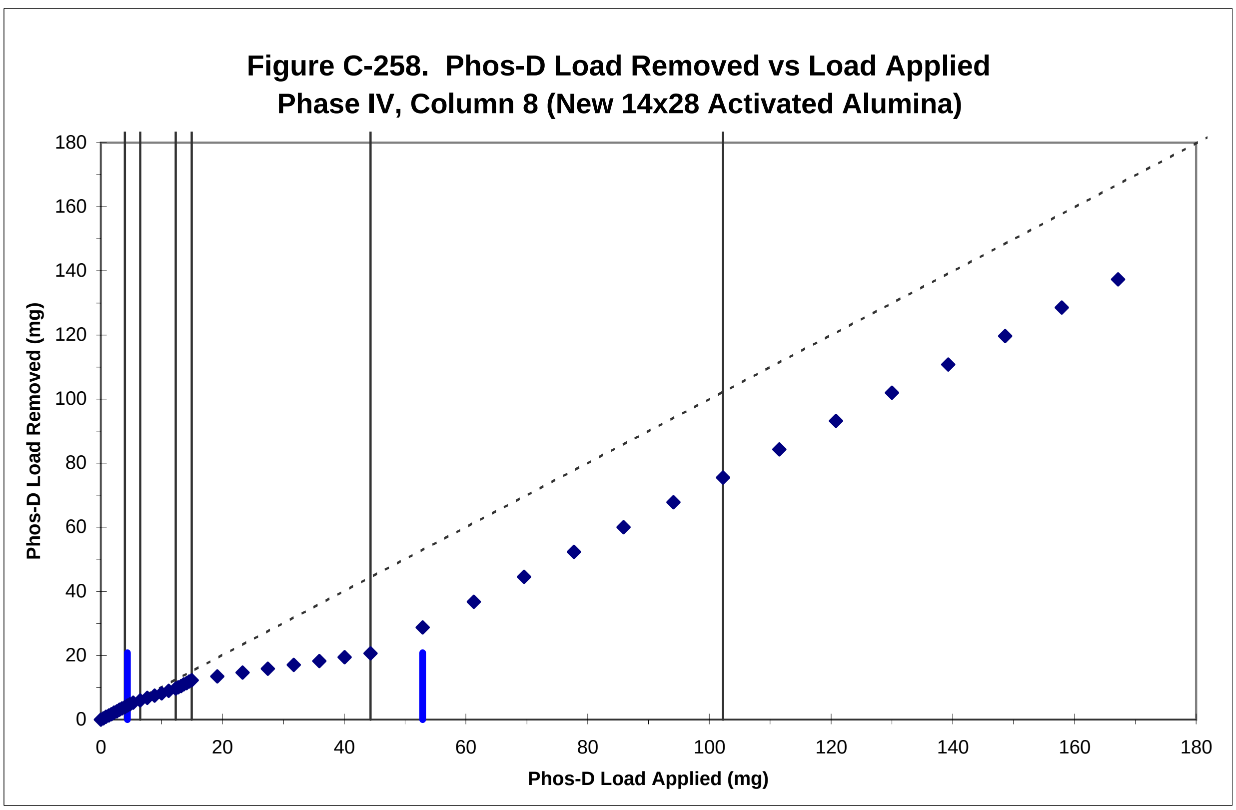


Figure C-258. Phos-D Load Removed vs Load Applied
Phase IV, Column 8 (New 14x28 Activated Alumina)
Phos-D Load Removed (mg)
Phos-D Load Applied (mg)
0
20
40
60
80
100
120
140
160
180

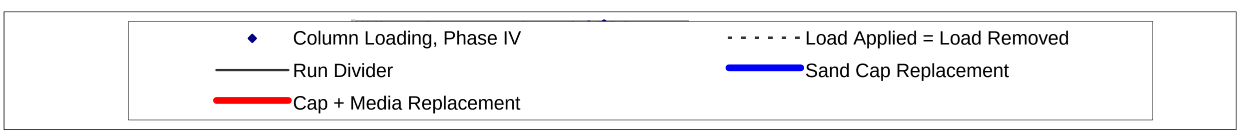

Column Loading, Phase IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

Figure C-259. Phos-D Load Removed vs Load Applied
Phase IV, Column 9 (Superior 30 Sand)

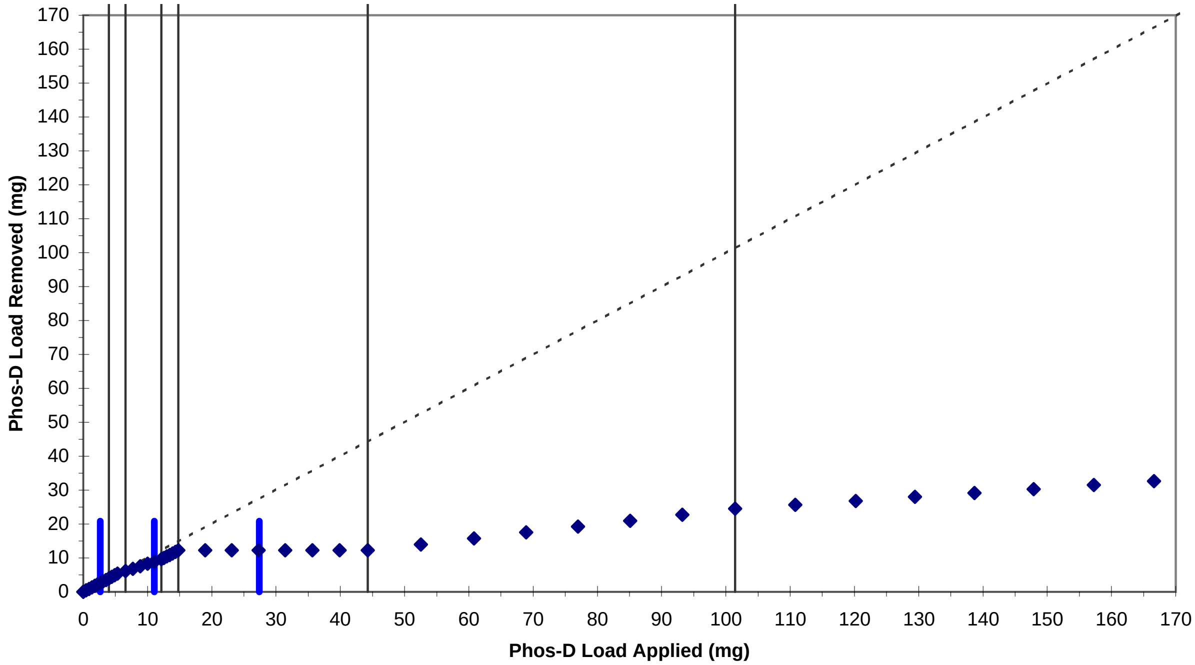
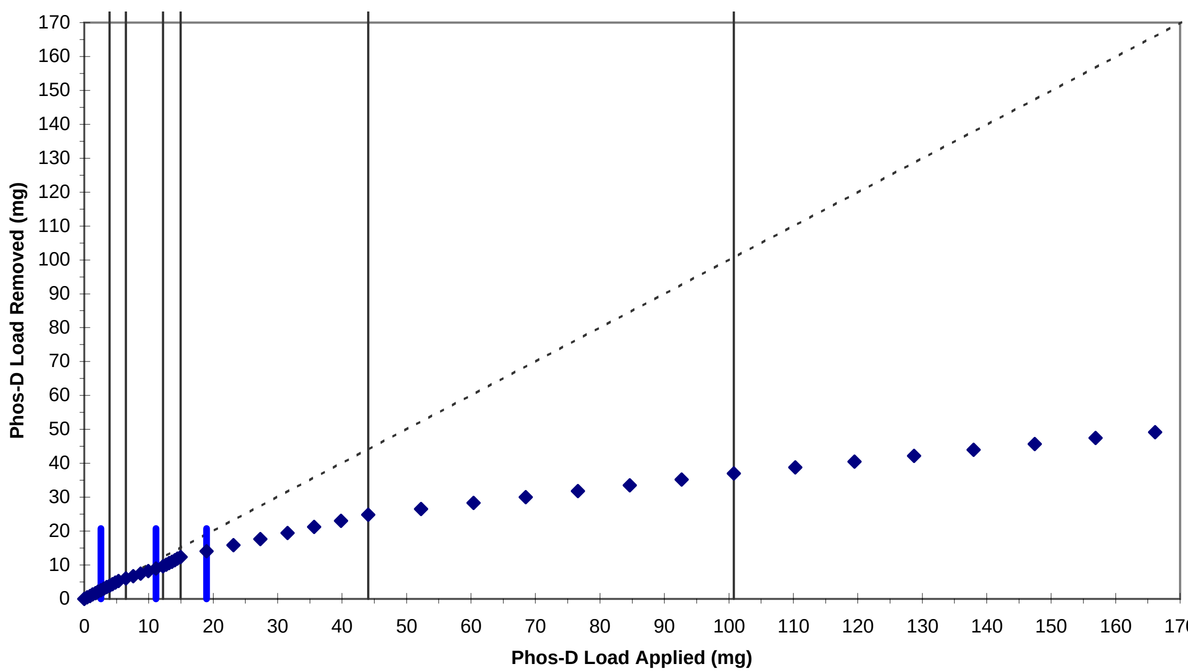


Figure C-260. Phos-D Load Removed vs Load Applied
Phase IV, Column 10 (Superior 30 Sand)



Column Loading, Phase IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

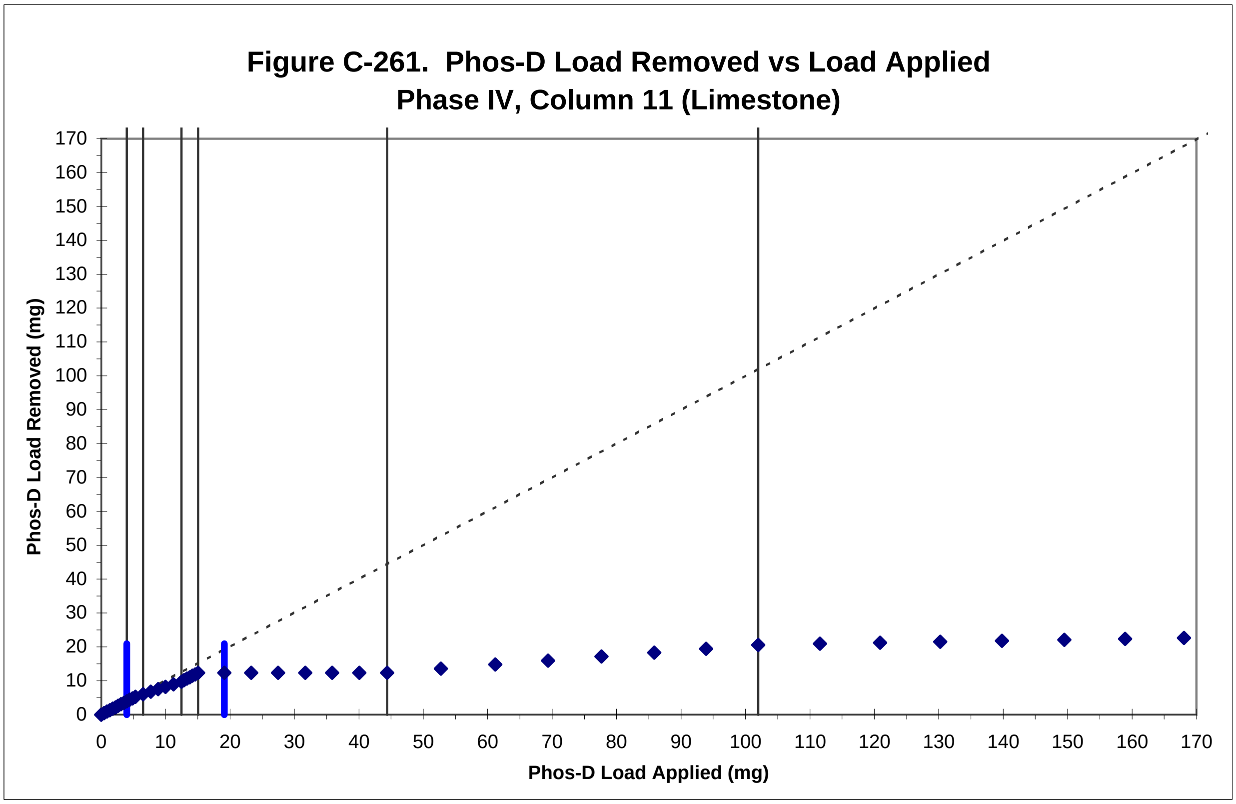


Figure C-261. Phos-D Load Removed vs Load Applied
Phase IV, Column 11 (Limestone)
Phos-D Load Removed (mg)
Phos-D Load Applied (mg)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170

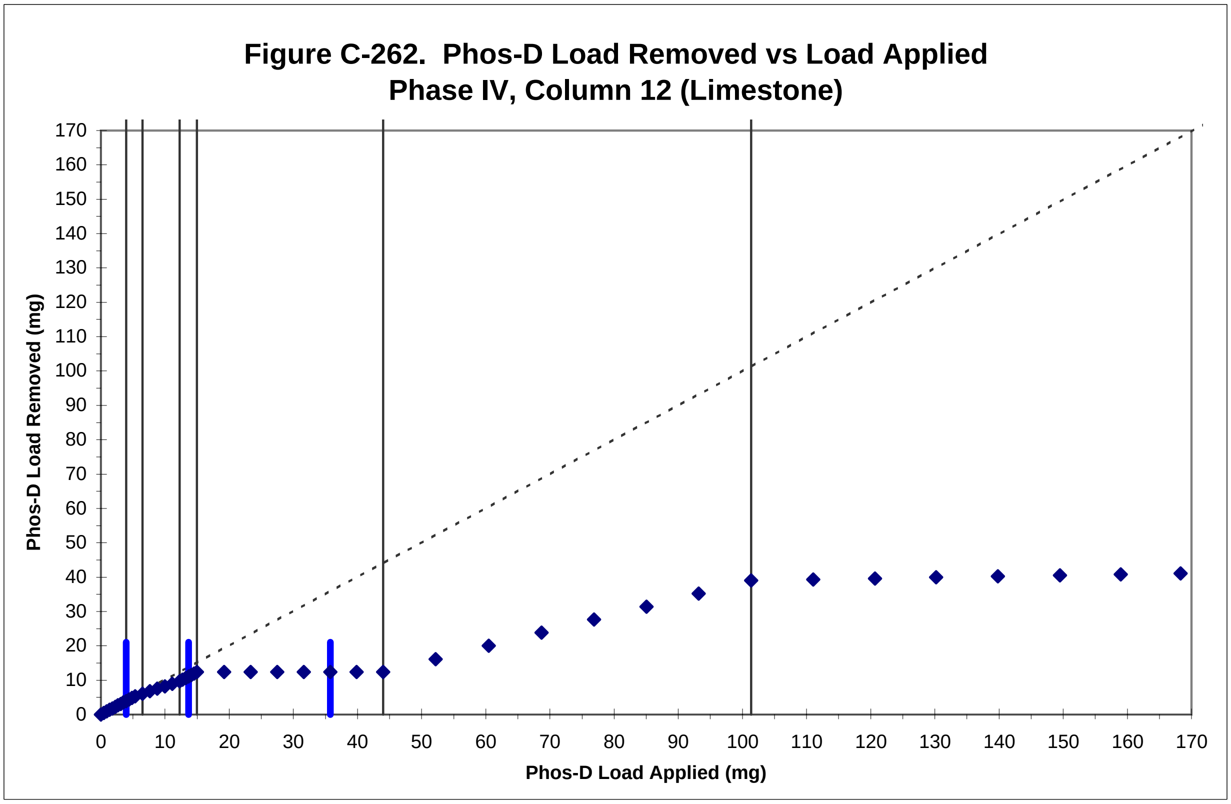
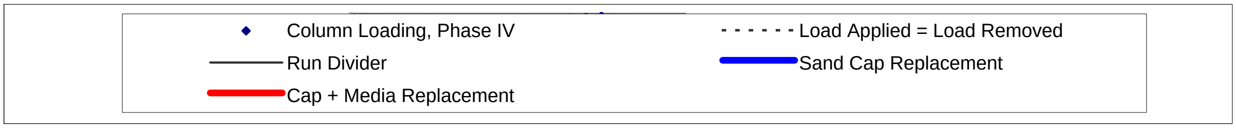


Figure C-262. Phos-D Load Removed vs Load Applied
Phase IV, Column 12 (Limestone)
Phos-D Load Removed (mg)
Phos-D Load Applied (mg)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170


Column Loading, Phase IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

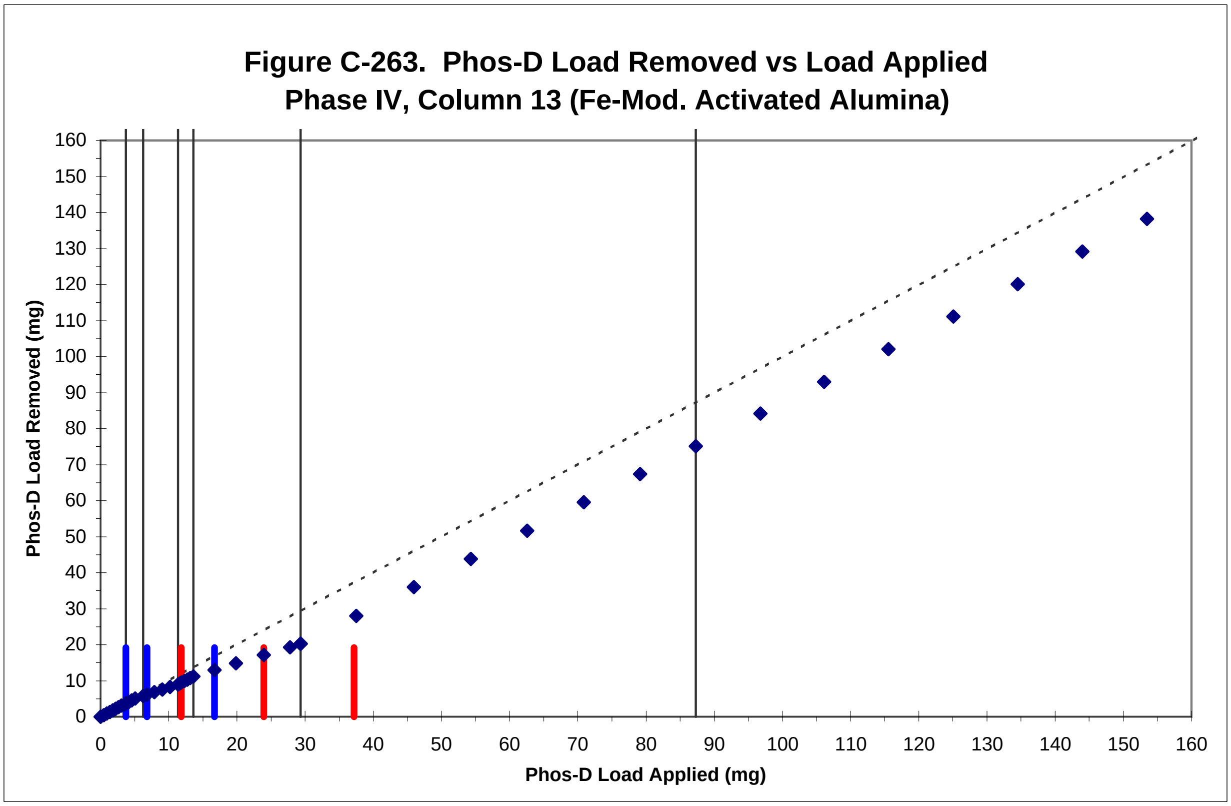


Figure C-263. Phos-D Load Removed vs Load Applied
Phase IV, Column 13 (Fe-Mod. Activated Alumina)
Phos-D Load Removed (mg)
Phos-D Load Applied (mg)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160

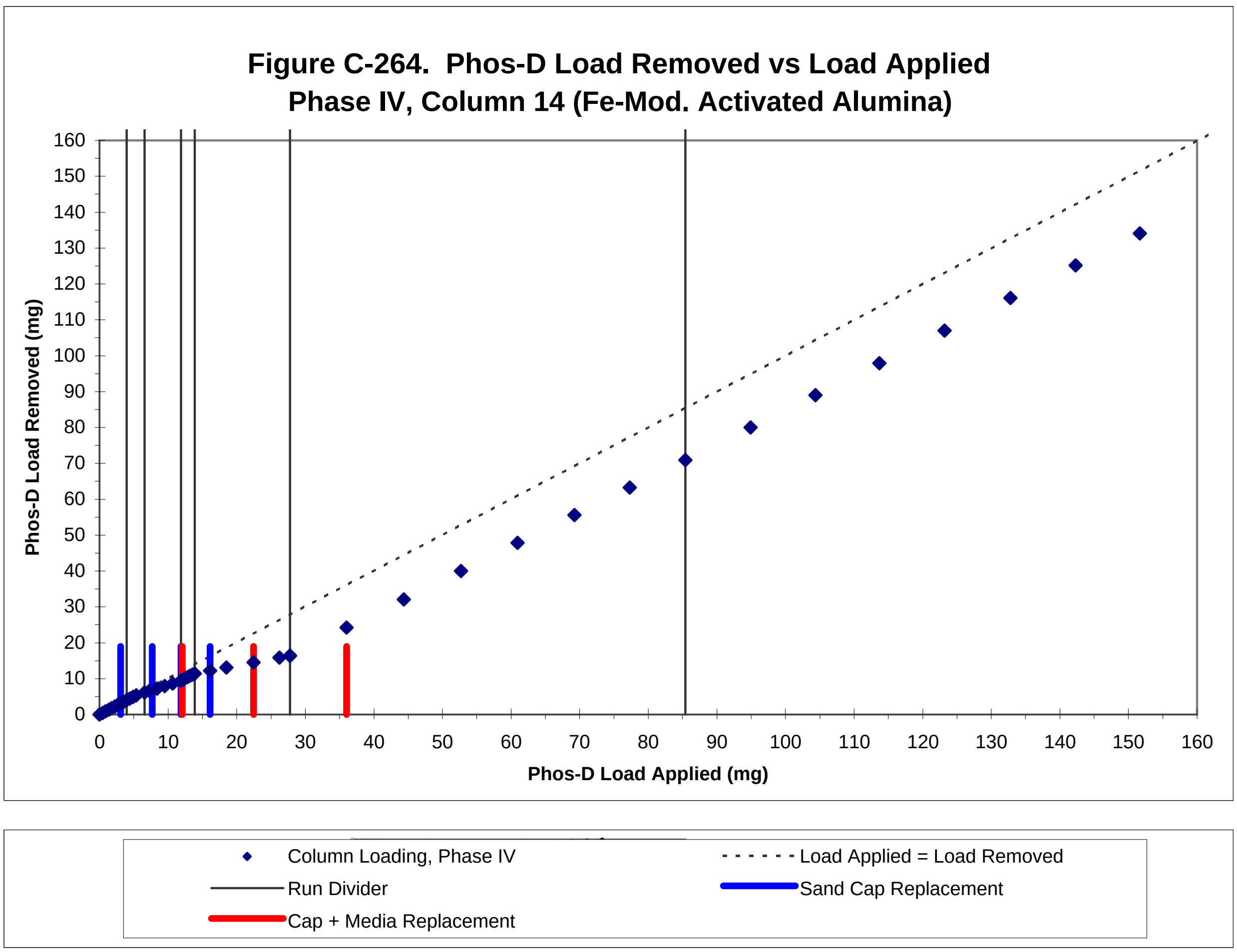


Figure C-264. Phos-D Load Removed vs Load Applied
Phase IV, Column 14 (Fe-Mod. Activated Alumina)
Phos-D Load Removed (mg)
Phos-D Load Applied (mg)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
Column Loading, Phase IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

Figure C-265. Phos-D Load Removed vs Load Applied
Phase IV, Column 15 (GFH)

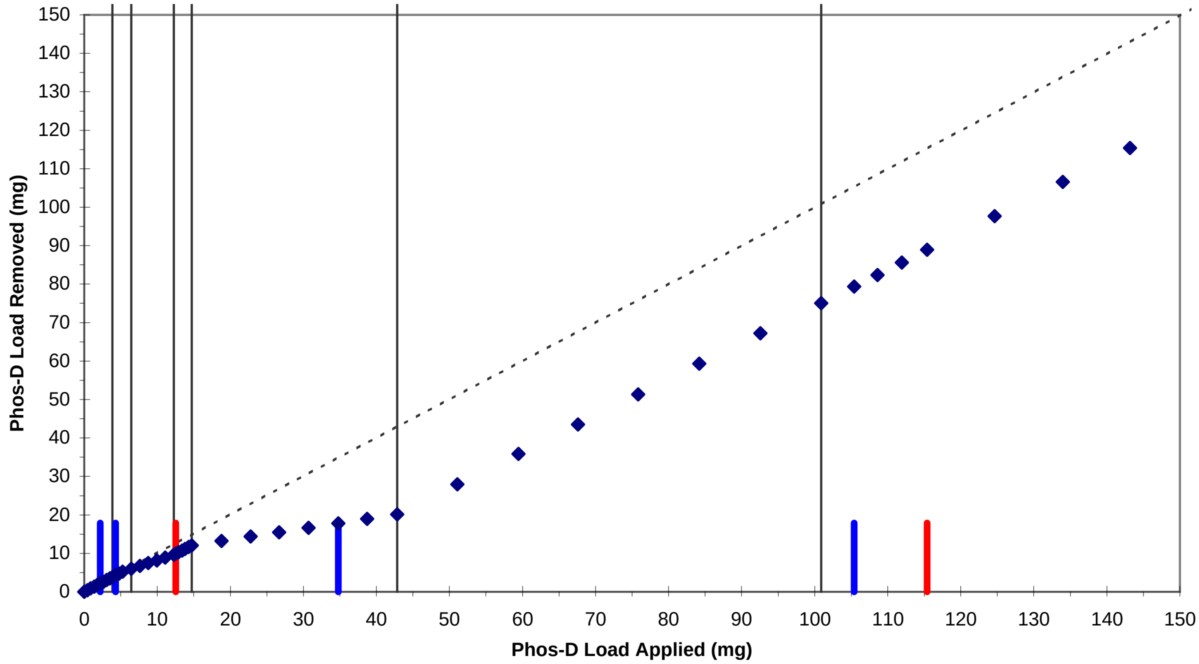
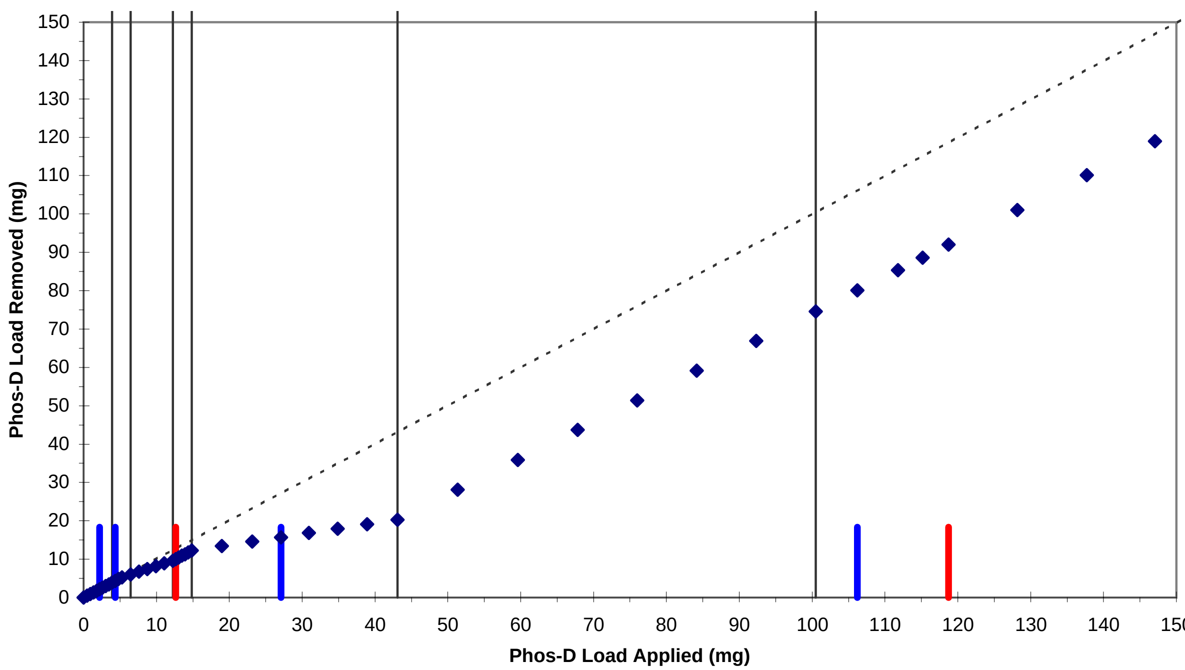
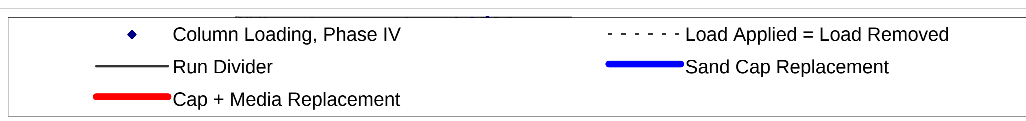


Figure C-266. Phos-D Load Removed vs Load Applied
Phase IV, Column 16 (GFH)





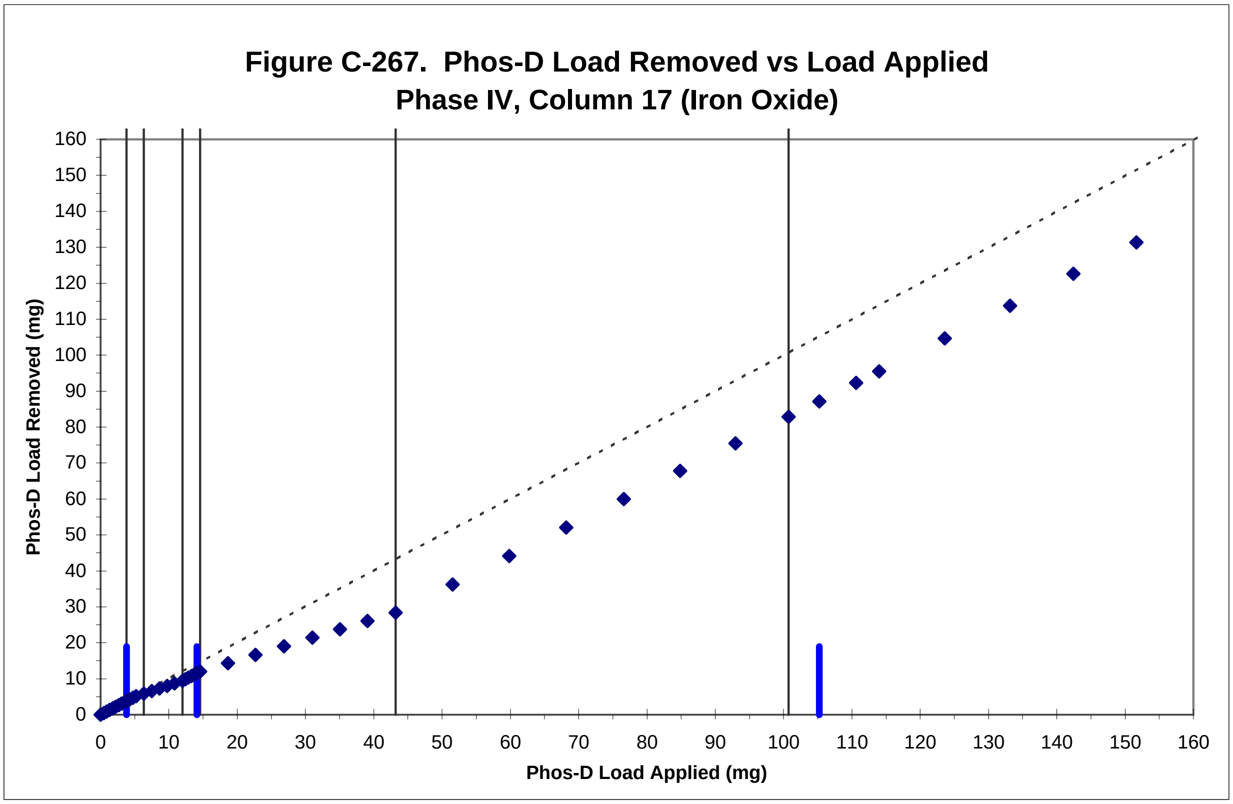


Figure C-267. Phos-D Load Removed vs Load Applied
Phase IV, Column 17 (Iron Oxide)
Phos-D Load Removed (mg)
Phos-D Load Applied (mg)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160

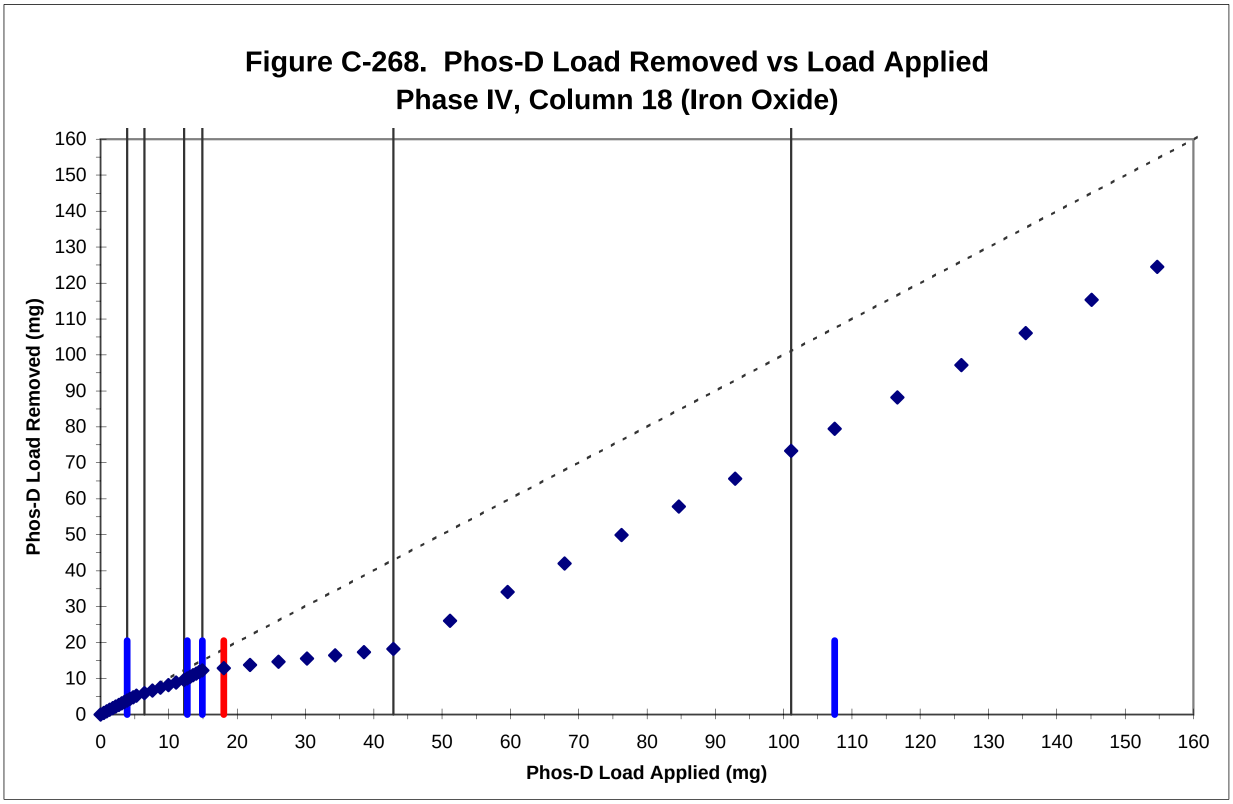
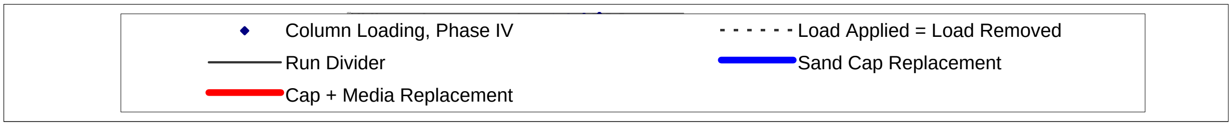


Figure C-268. Phos-D Load Removed vs Load Applied
Phase IV, Column 18 (Iron Oxide)
Phos-D Load Removed (mg)
Phos-D Load Applied (mg)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160


Column Loading, Phase IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

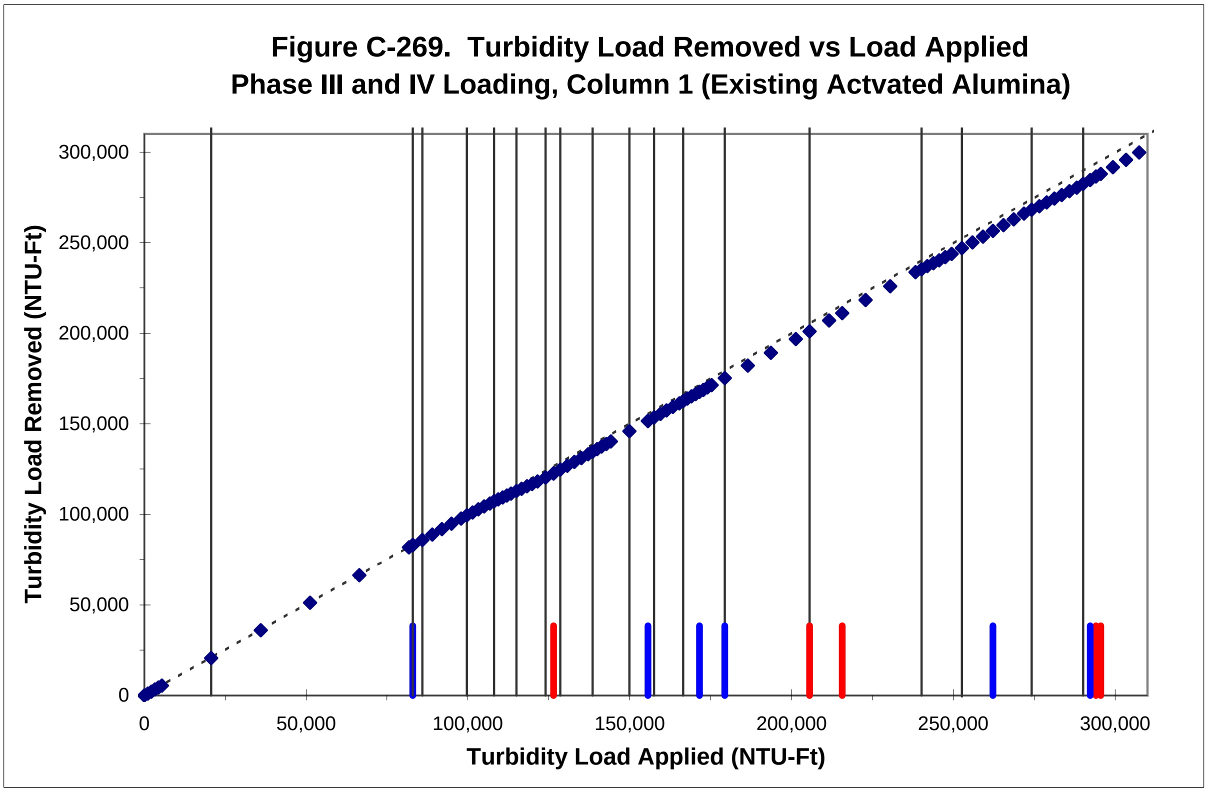


Figure C-269. Turbidity Load Removed vs Load Applied
Phase III and IV Loading, Column 1 (Existing Actvated Alumina)
Turbidity Load Removed (NTU-Ft)
300,000
250,000
200,000
150,000
100,000
50,000
0
0
50,000
100,000
150,000
200,000
250,000
300,000
Turbidity Load Applied (NTU-Ft)

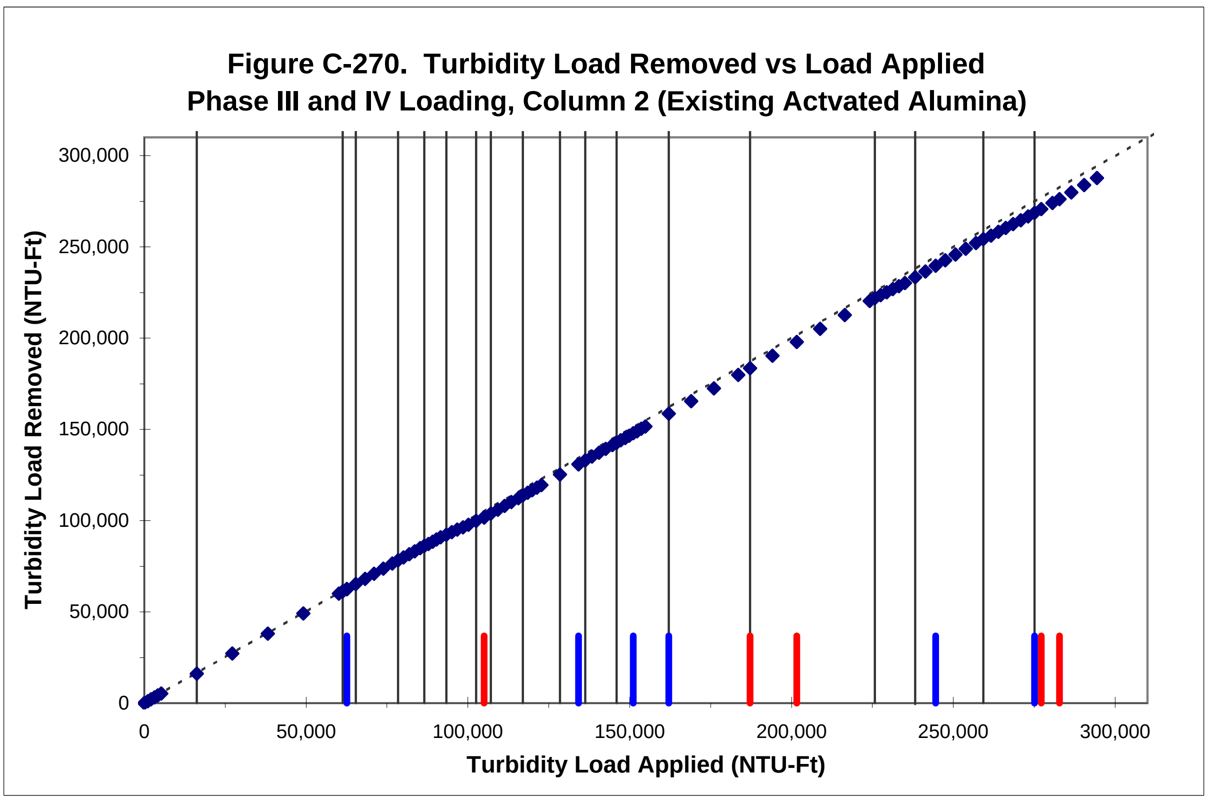


Figure C-270. Turbidity Load Removed vs Load Applied
Phase III and IV Loading, Column 2 (Existing Actvated Alumina)
Turbidity Load Removed (NTU-Ft)
300,000
250,000
200,000
150,000
100,000
50,000
0
0
50,000
100,000
150,000
200,000
250,000
300,000
Turbidity Load Applied (NTU-Ft)

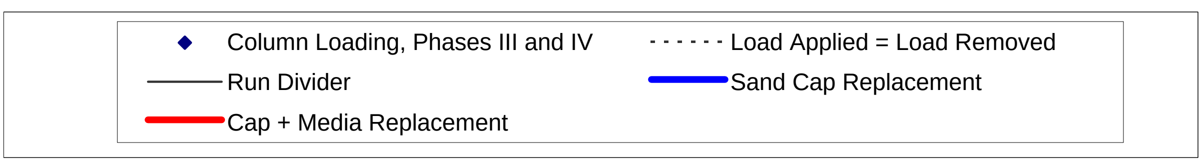

Column Loading, Phases III and IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

Figure C-271. Turbidity Load Removed vs Load Applied
Phase III and IV Loading, Column 3 (Existing F-105 Filter Sand)

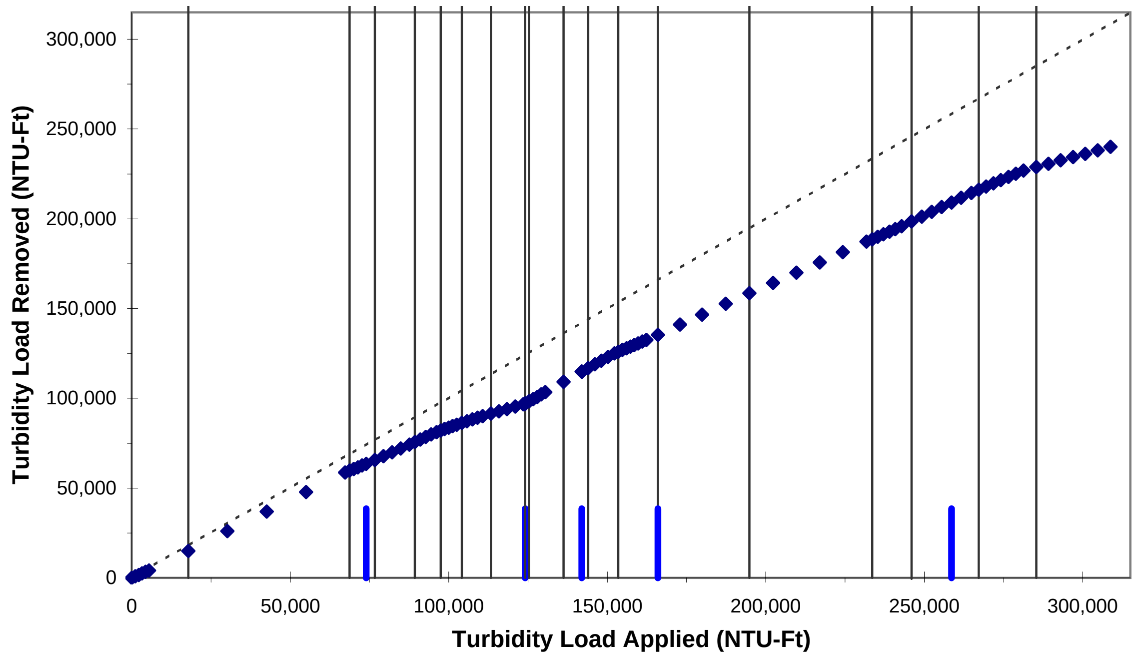
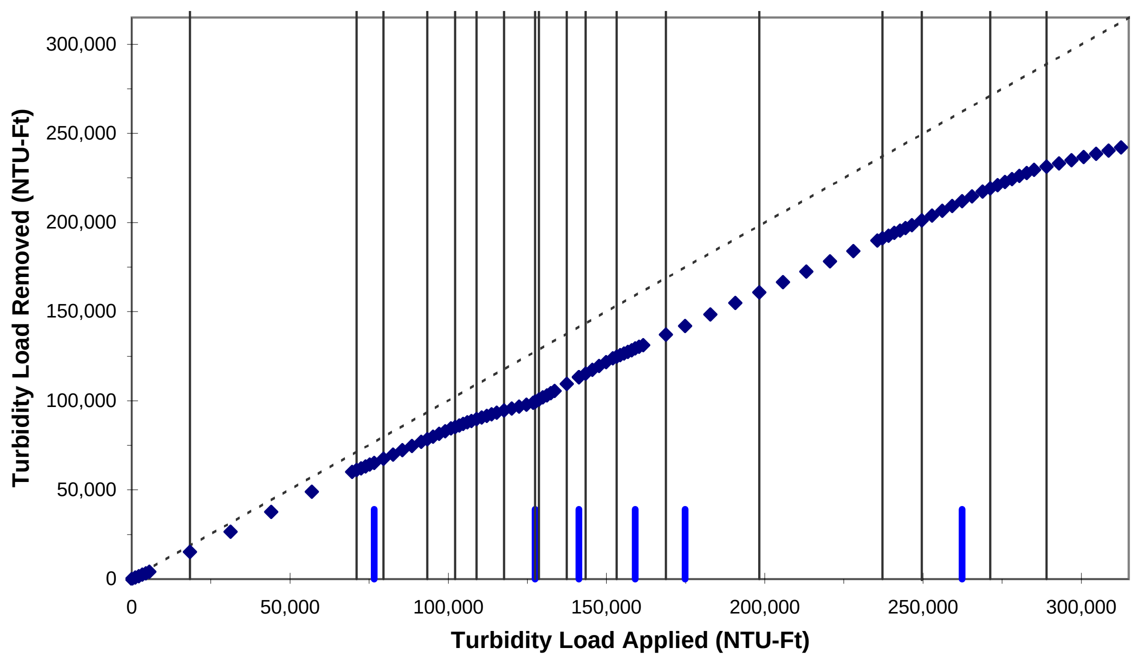


Figure C-272. Turbidity Load Removed vs Load Applied
Phase III and IV Loading, Column 4 (Existing F-105 Filter Sand)



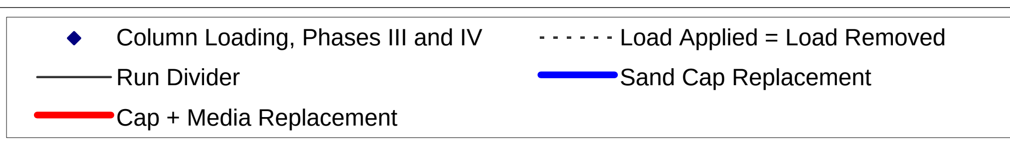


Figure C-273. TSS Load Removed vs Load Applied
Phase III and IV Loading, Column 1 (Existing Actvated Alumina)

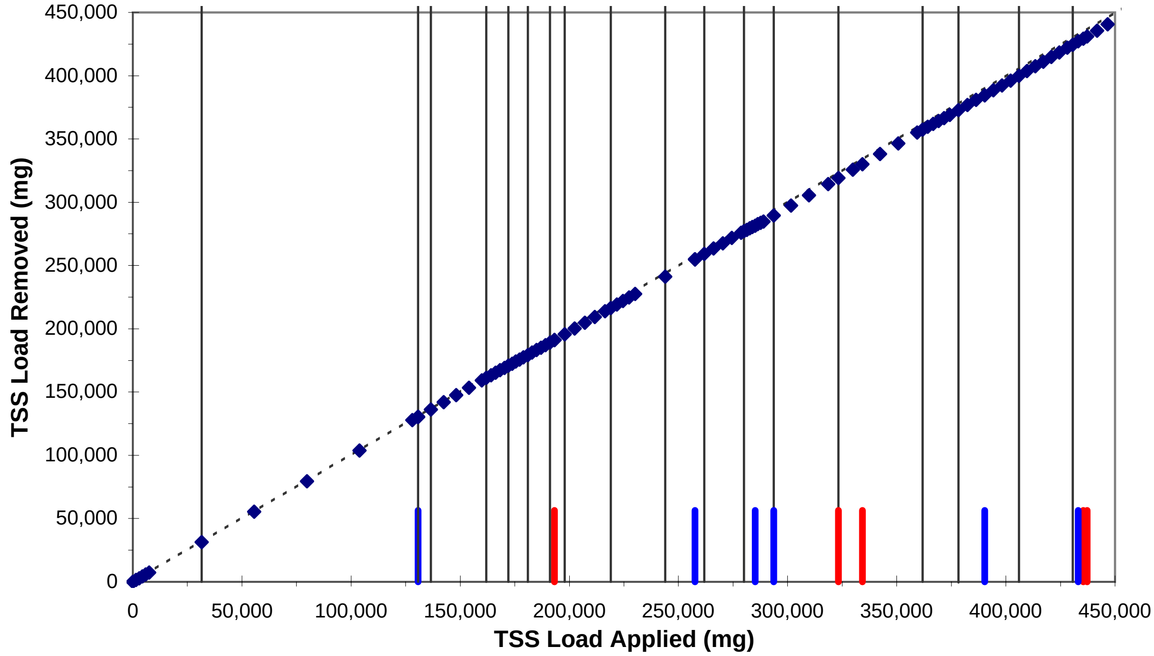
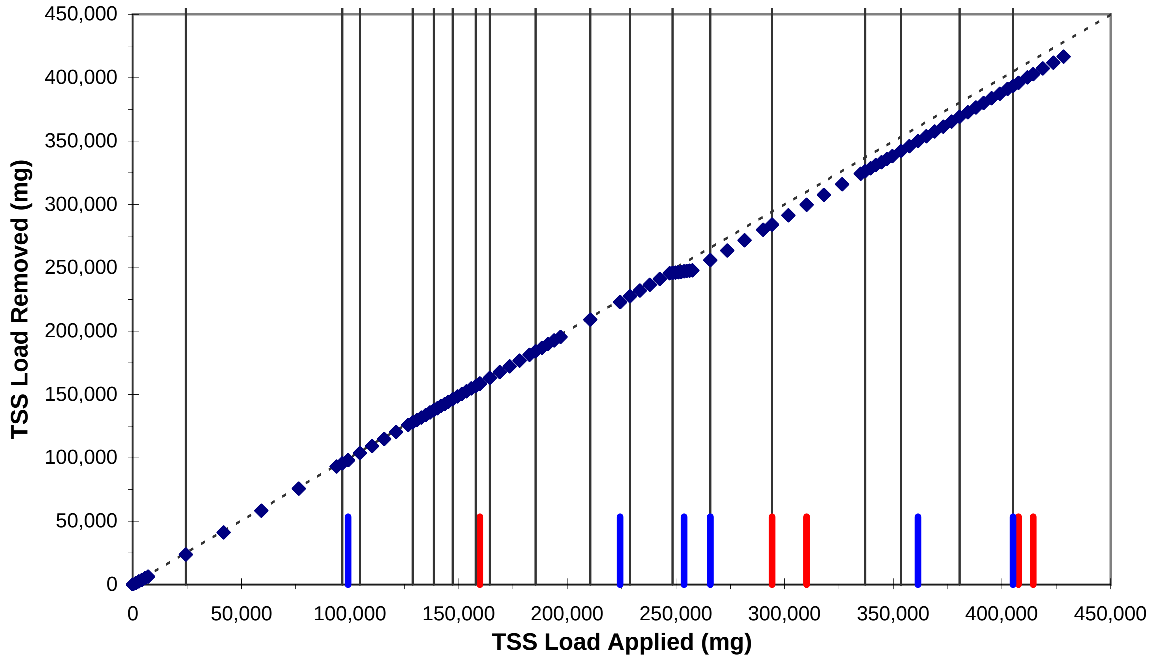
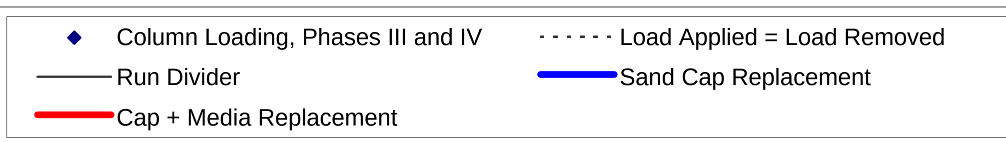


Figure C-274. TSS Load Removed vs Load Applied
Phase III and IV Loading, Column 2 (Existing Actvated Alumina)





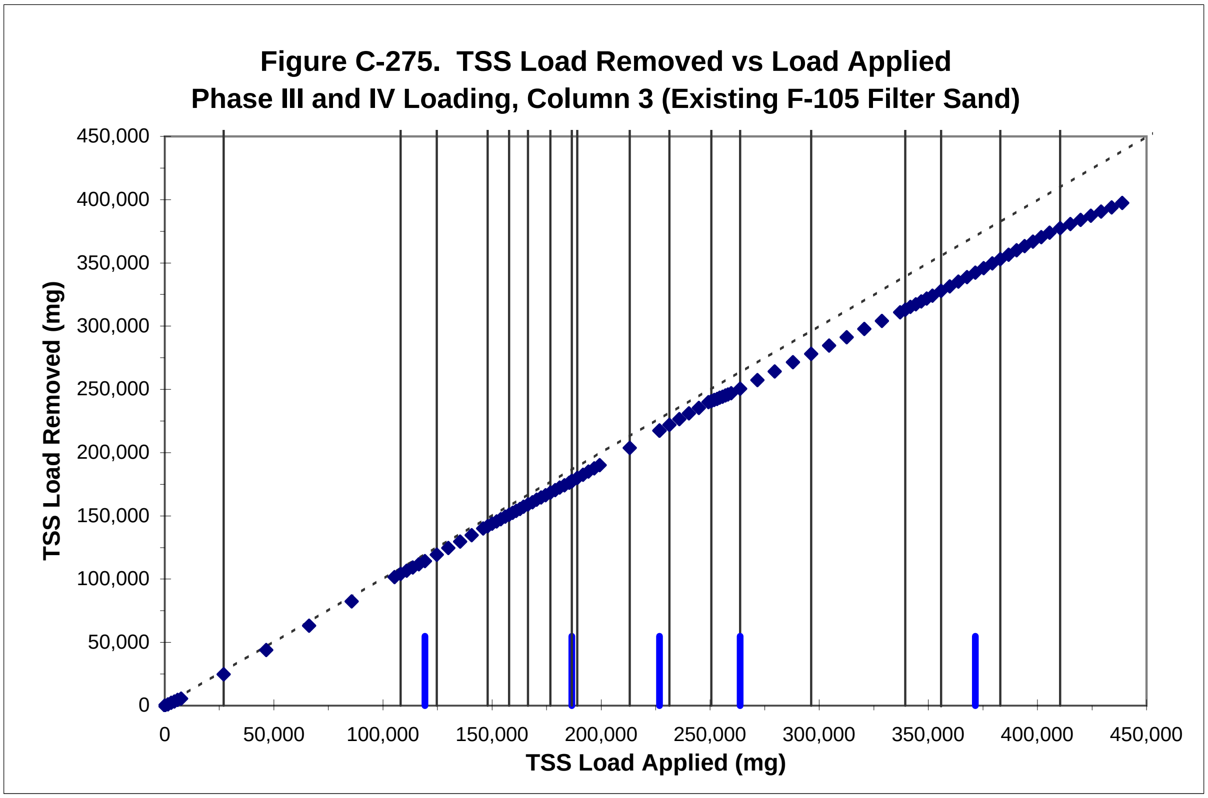


Figure C-275. TSS Load Removed vs Load Applied
Phase III and IV Loading, Column 3 (Existing F-105 Filter Sand)
TSS Load Removed (mg)
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
0
50,000
100,000
150,000
200,000
250,000
300,000
350,000
400,000
450,000
TSS Load Applied (mg)

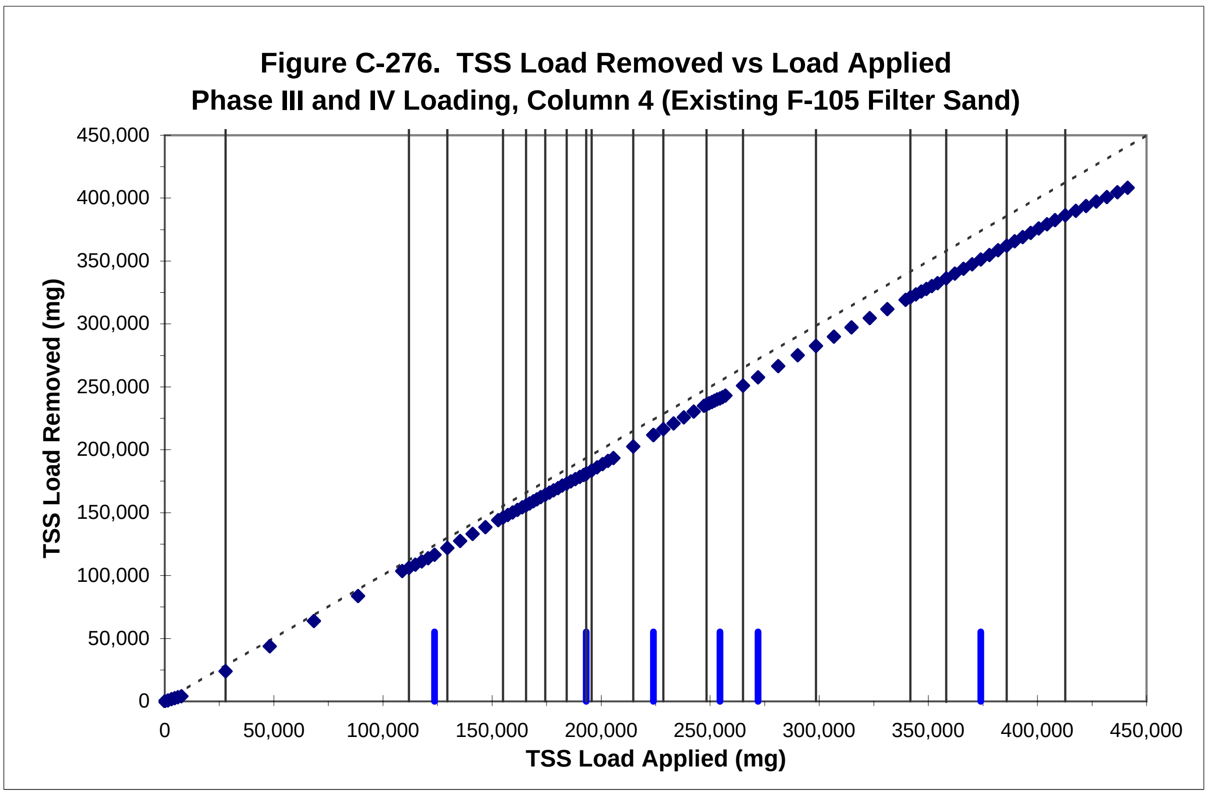


Figure C-276. TSS Load Removed vs Load Applied
Phase III and IV Loading, Column 4 (Existing F-105 Filter Sand)
TSS Load Removed (mg)
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
0
50,000
100,000
150,000
200,000
250,000
300,000
350,000
400,000
450,000
TSS Load Applied (mg)

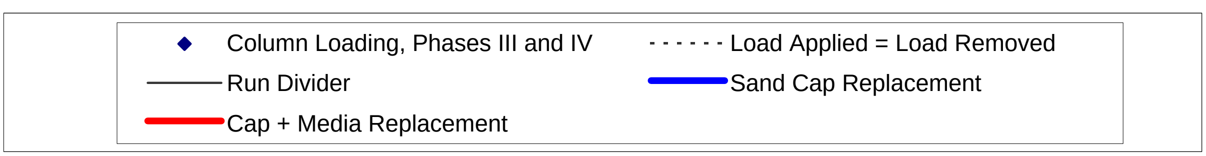

Column Loading, Phases III and IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

Figure C-277. Phos-T Load Removed vs Load Applied
Phase III and IV Loading, Column 1 (Existing Actvated Alumina)

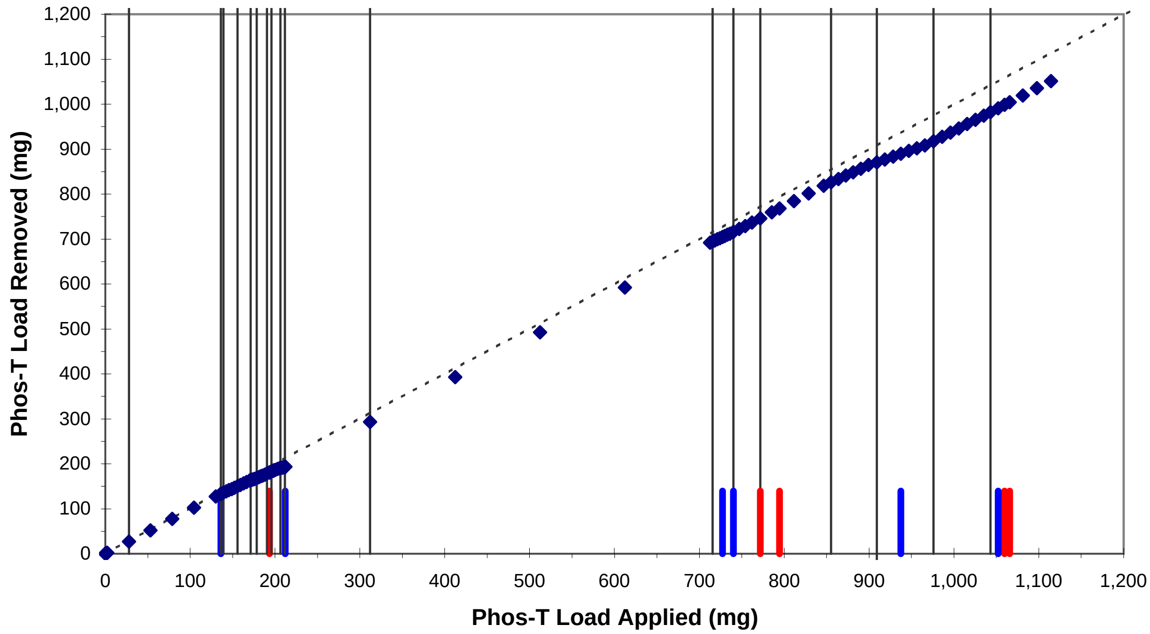
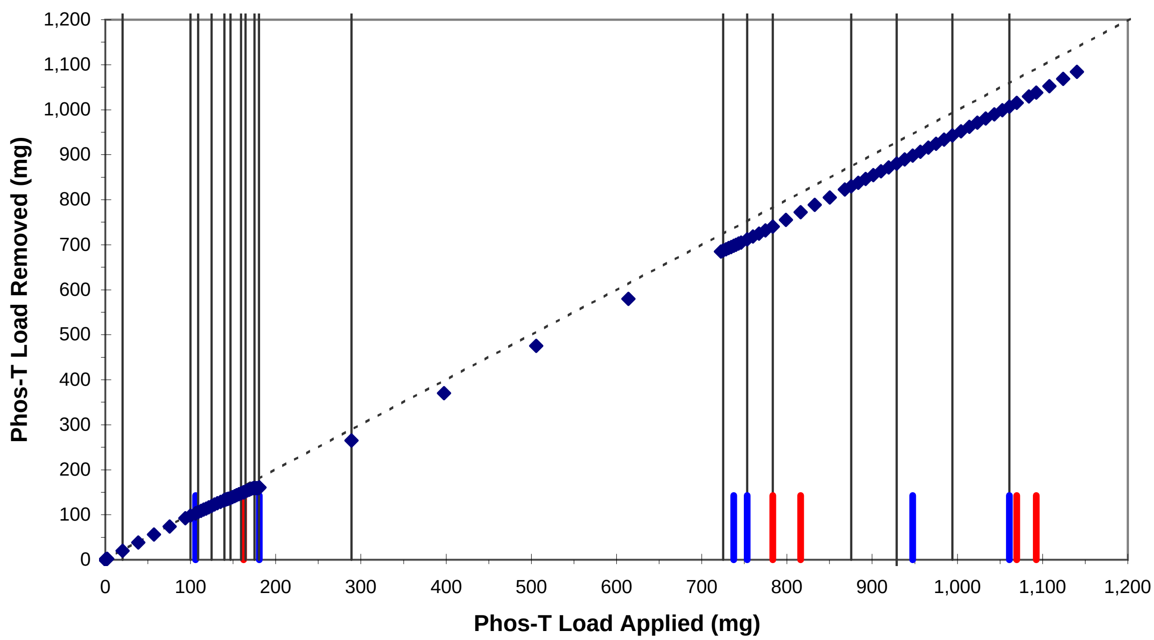
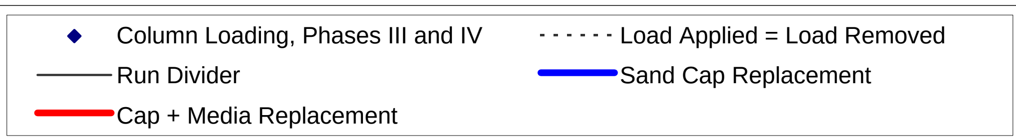


Figure C-278. Phos-T Load Removed vs Load Applied
Phase III and IV Loading, Column 2 (Existing Actvated Alumina)





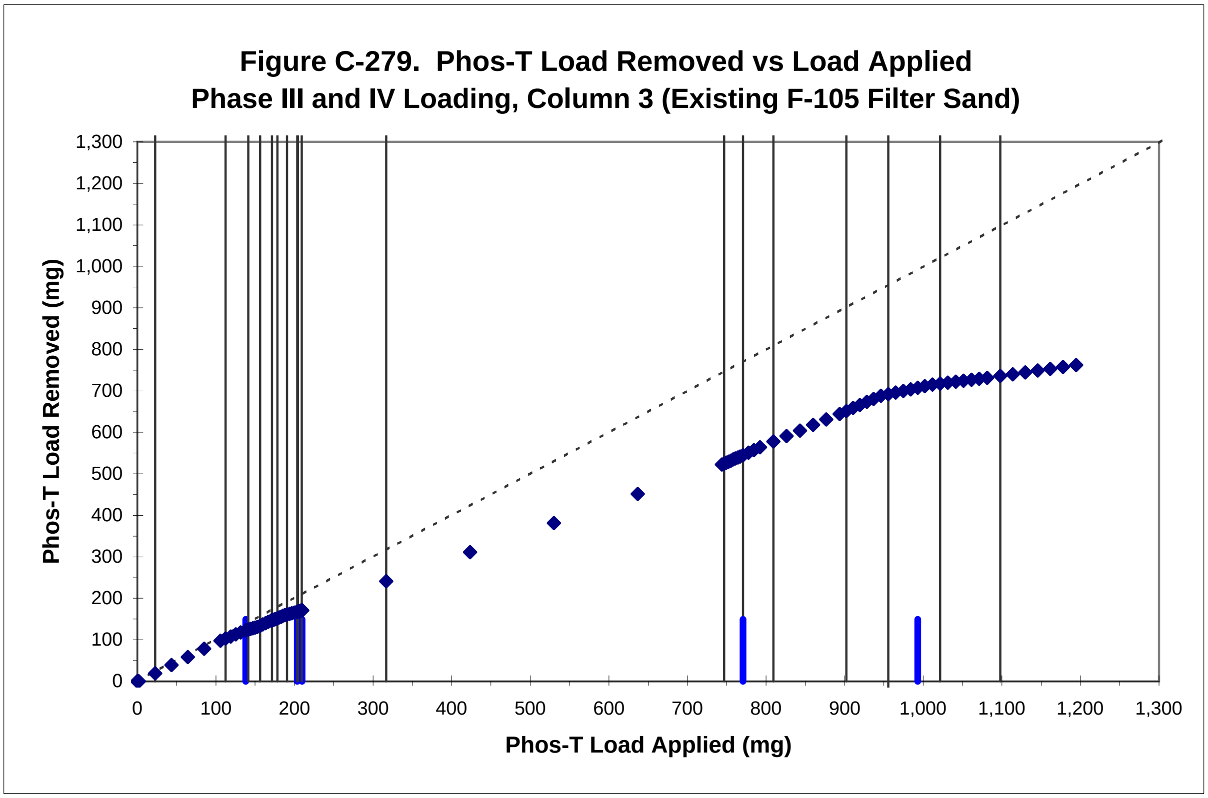


Figure C-279. Phos-T Load Removed vs Load Applied
Phase III and IV Loading, Column 3 (Existing F-105 Filter Sand)
Phos-T Load Removed (mg)
Phos-T Load Applied (mg)
0
100
200
300
400
500
600
700
800
900
1,000
1,100
1,200
1,300

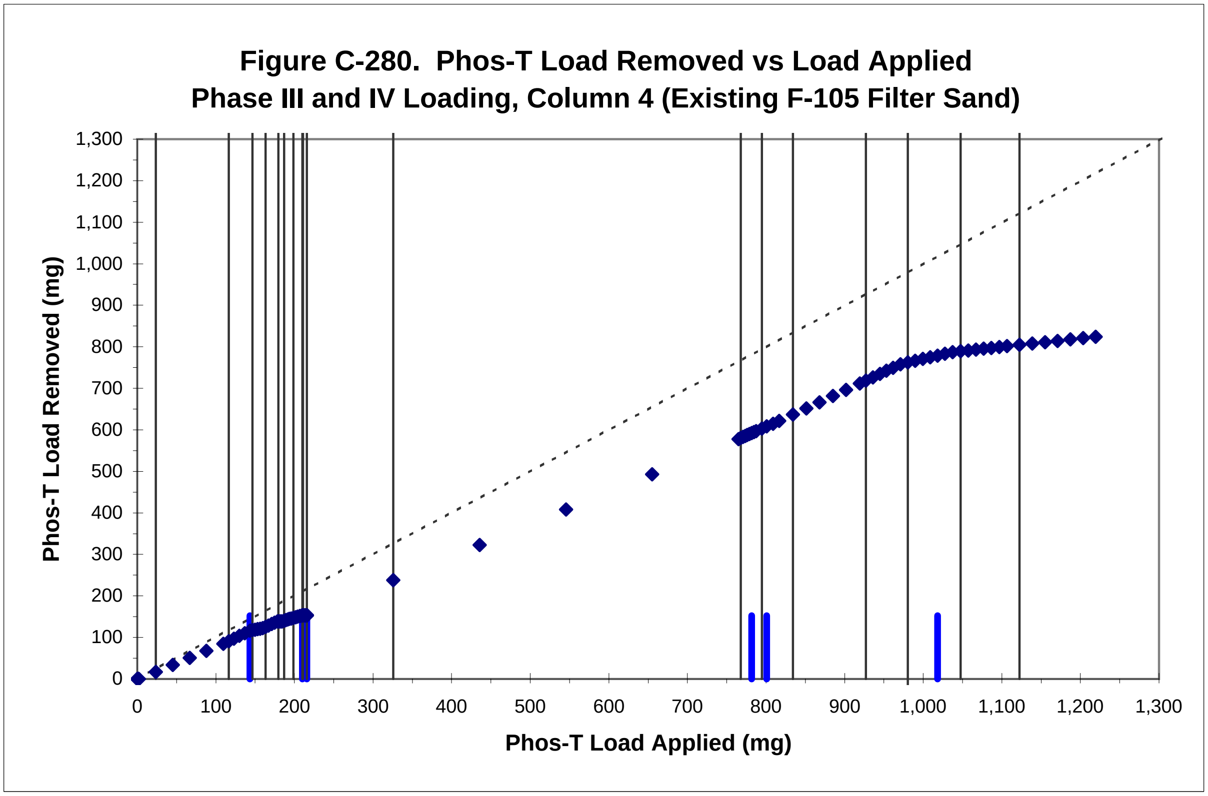
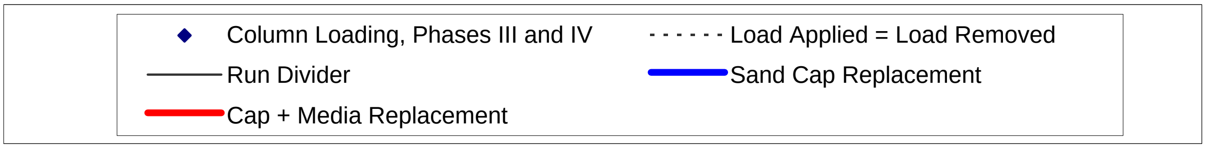


Figure C-280. Phos-T Load Removed vs Load Applied
Phase III and IV Loading, Column 4 (Existing F-105 Filter Sand)
Phos-T Load Removed (mg)
Phos-T Load Applied (mg)
0
100
200
300
400
500
600
700
800
900
1,000
1,100
1,200
1,300


Column Loading, Phases III and IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

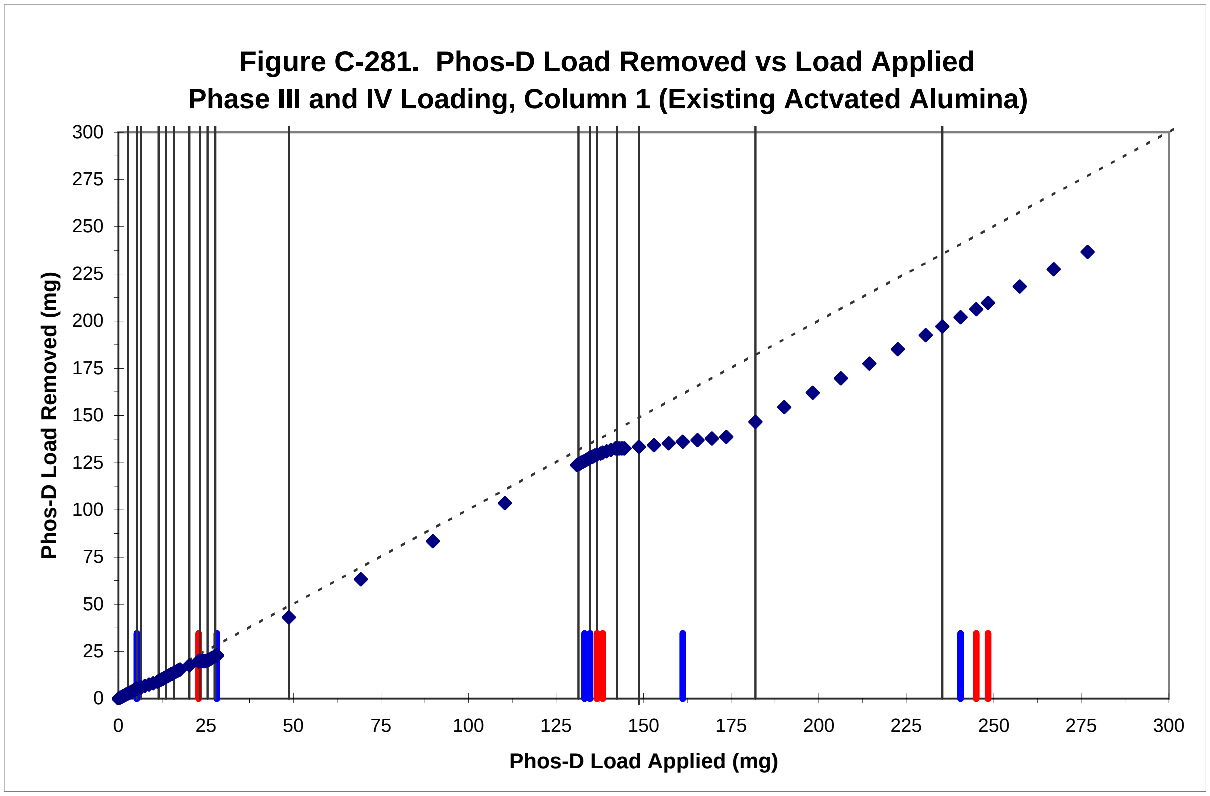


Figure C-281. Phos-D Load Removed vs Load Applied
Phase III and IV Loading, Column 1 (Existing Actvated Alumina)
Phos-D Load Removed (mg)
Phos-D Load Applied (mg)
0
25
50
75
100
125
150
175
200
225
250
275
300

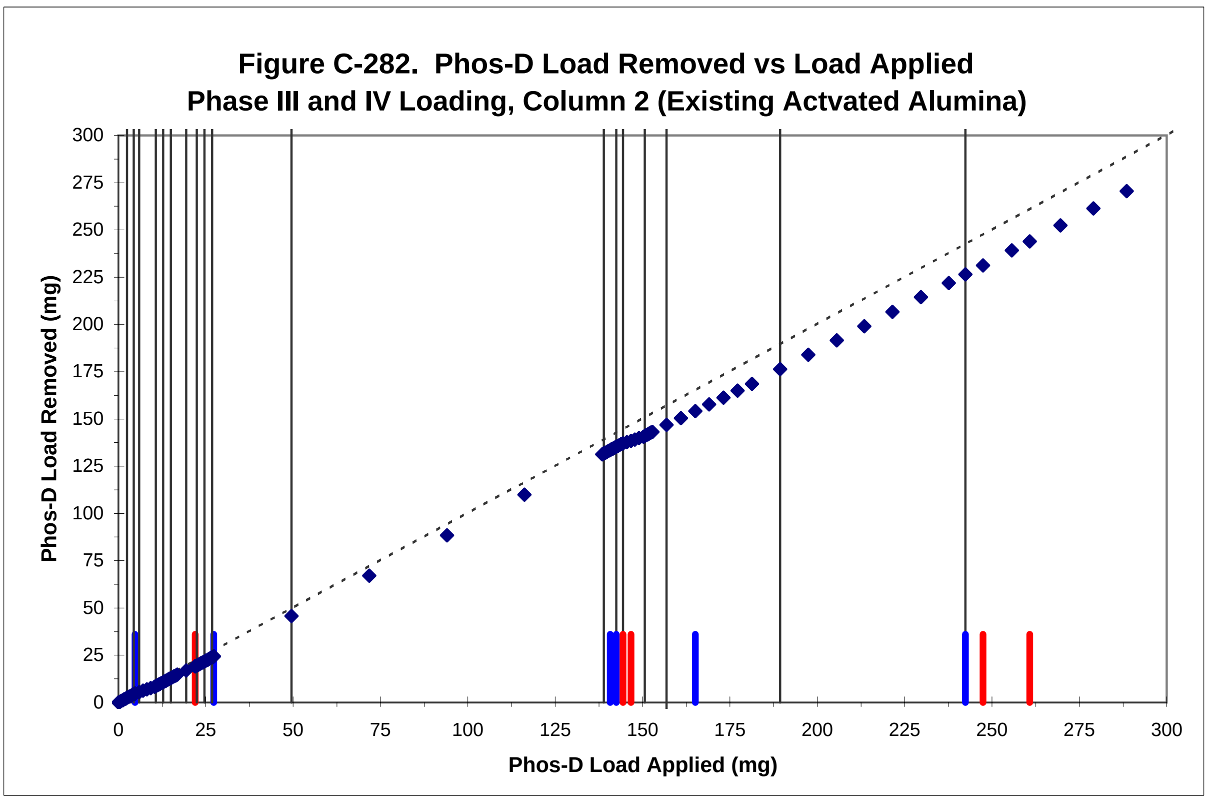


Figure C-282. Phos-D Load Removed vs Load Applied
Phase III and IV Loading, Column 2 (Existing Actvated Alumina)
Phos-D Load Removed (mg)
Phos-D Load Applied (mg)
0
25
50
75
100
125
150
175
200
225
250
275
300

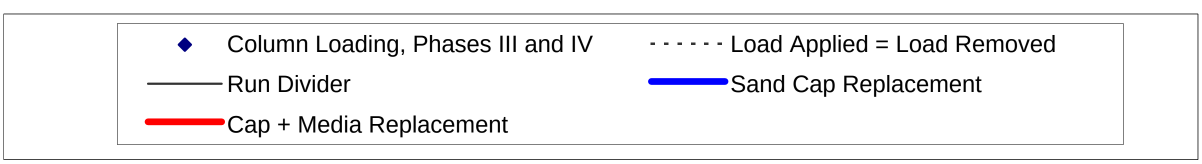

Column Loading, Phases III and IV
Load Applied = Load Removed
Run Divider
Sand Cap Replacement
Cap + Media Replacement

Figure C-283. Phos-D Load Removed vs Load Applied
Phase III and IV Loading, Column 3 (Existing F-105 Filter Sand)

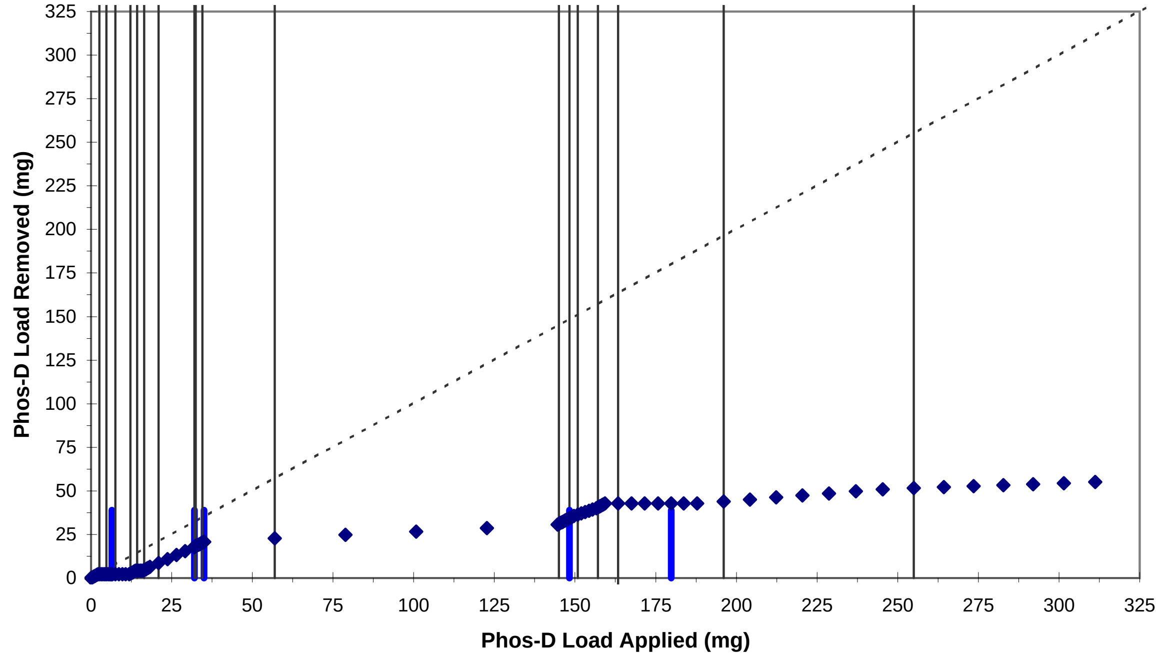
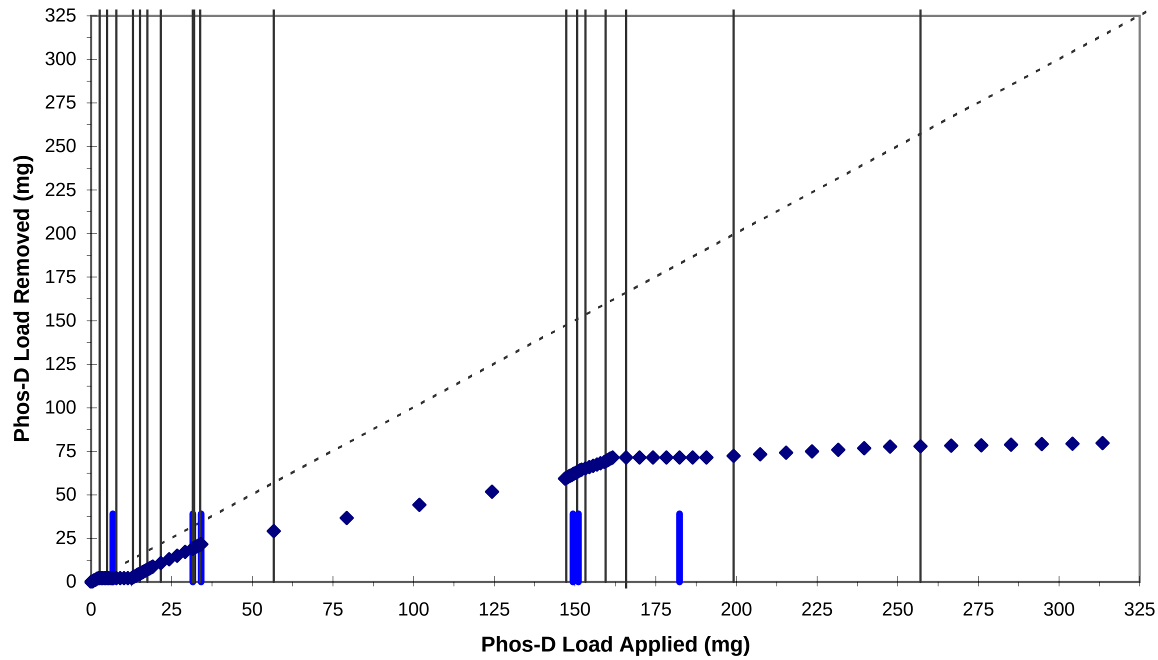
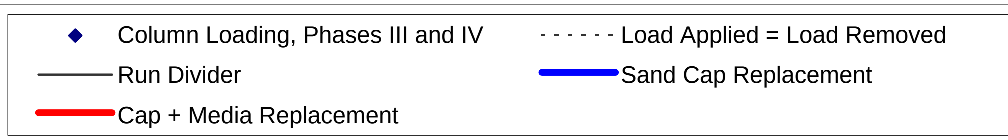


Figure C-284. Phos-D Load Removed vs Load Applied
Phase III and IV Loading, Column 4 (Existing F-105 Filter Sand)





Appendix D

Jar Test Experiments – Data

Table D-1. Jar Test Data, Run 17A

Chemical =	**PAX-XL9**
Date Run =	11/13/2004
Water Source =	On-site Basin
Time Run, Range =	14:00 - 15:45
Mixing Condition =	Standard
Jar Temp Range (C) =	7.5 - 8.8
Jar pH Range (SU) =	5.9 - 7.0
EC Range (uS) =	>4,000

Initial Temp (C) = 3.3

	Turbidity (NTU)			Turbidity (NTU)		Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0	160	158	25	146	73.9	66.4	31.1
15	103	53.4	50	81.3	43.3	24.1	14.7
25	43.2	22.5	75	78.4	41.5	22.9	16.3
50	20.0	13.0	100	161	99.7	33.2	23.9
60	21.6	14.5	125	164	109	56.9	42.4
70 (BTD)	17.4	10.9	150	168	170	93.9	61.2
75	17.5	10.9					
80	18.0	12.0					
90	17.1	11.7					
100 (sampled)	19.3	14.1					
120	25.8	20.8					
150	90.0	45.8					
175	160	75.3					
200	165	168					
250	167	176					

Table D-2. Jar Test Data, Run 17A

Chemical =	**PASS-C**
Date Run =	11/14/2004
Water Source =	On-site Basin
Time Run, Range =	14:45 - 15:30
Mixing Condition =	Standard
Jar Temp Range (C) =	7.2 - 9.0
Jar pH Range (SU) =	5.3 - 7.0
EC Range (uS) =	>4,000

Initial Temp (C) = 4.0

	Turbidity (NTU)			Turbidity (NTU)		Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0	157	162	20	126	49.5	44.9	18.1
10	155	151	30	112	49.5	32.3	14.2
20	75.7	33.3	40	104	48.7	27.0	13.6
25	26.5	19.2	50	108	43.7	24.0	12.5
30	37.4	13.8	80	87.4	41.4	20.9	13.4
40	25.3	9.8	110	86.1	38.5	27.2	23.6
50 (BTD)	22.3	8.9					
60	23.5	10.1					
75	27.2	13.5					
80	36.4	22.2					
100 (sampled)	24.6	15.2					
125	25.6	20.3					
150	22.6	21.8					
175	56.6	45.0					
200	105	92.9					
250	157	168					
300	167	174					
400	165	182					

Table D-3. Jar Test Data, Run 17A

Chemical =	**Sumalchlor 50**
Date Run =	11/14/2004
Water Source =	On-site Basin
Time Run, Range =	11:30 - 13:40
Mixing Condition =	Standard
Jar Temp Range (C) =	5.5 - 9.2
Jar pH Range (SU) =	6.4 - 7.3
EC Range (uS) =	>4,000

Initial Temp (C) = 3.3

	Turbidity (NTU)			Turbidity (NTU)		Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0	158	153	0	166	156	155	151
5	155	148	10	157	113	105	44.3
10	117	54.5	20	161	140	118	49.3
15	78.7	35.6	30	167	166	159	104
20	74.5	33.6	40	168	164	164	159
25 (BTD)	71.9	32.2	60	172	165	170	166
30	76.2	37.0					
35	94.1	47.2					
40	146	72.3					
45	166	147					
50	169	159					
75	177	179					
100 (sampled)	185	181					
125	177	180					
150	179	175					
175	180	178					
200	173	177					
250	176	178					
300	175	184					
400	177	182					

Table D-4. Jar Test Data, Run 17A

Chemical =	**JC 1720**
Date Run =	11/13/2004
Water Source =	On-site Basin
Time Run, Range =	9:20 - 11:20
Mixing Condition =	Standard
Jar Temp Range (C) =	7.8 - 8.5
Jar pH Range (SU) =	5.3 - 7.2
EC Range (uS) =	>4,000

Initial Temp (C) = 2.6

	Turbidity (NTU)			Turbidity (NTU)		Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0	162	162	40	81.3	30.7	25.9	15.2
15	49.9	27.4	100	40.5	17.5	19.1	12.9
25	19.9	11.9	125	34.7	15.5	34.7	22.9
50	17.5	10.8	175	55.8	29.6	66.0	27.0
75	14.1	10.6	200	167	39.9	92.5	31.4
90	15.9	12.7	250	172	48.8	167	160
100 (sampled)	13.0	10.5					
120 (BTD)	12.5	10.2					
125	12.9	9.8					
130	14.9	12.6					
140	14.5	11.9					
150	14.6	11.5					
160	15.2	12.2					
175	28.9	19.3					
200	49.2	30.2					
250	168	173					
300	170	170					
400	179	173					

Table D-5. Jar Test Data, Run 17A

Chemical =	**PAM #1 (Cytec A100)**
Date Run =	11/13/2004
Water Source =	On-site Basin
Time Run, Range =	18:00 - 20:00
Mixing Condition =	Standard
Jar Temp Range (C) =	8.2 - 10.0
Jar pH Range (SU) =	7.1 - 7.2
EC Range (uS) =	>4,000

Initial Temp (C) = 3.0

	Turbidity (NTU)			Turbidity (NTU)		Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0.00	153	160	0.50	42.9	33.7	28.0	23.0
0.25	81.8	69.7	1.00	37.0	21.0	22.8	16.9
0.50	42.5	36.7	1.25	46.3	24.7	23.0	15.4
0.75	28.7	27.1	1.50	53.9	29.0	20.1	15.2
1.00	20.0	16.2	2.00	74.1	33.3	42.4	22.7
1.20 (BTD)	18.6	15.0	2.50	90.5	39.2	54.6	31.5
1.25	21.2	16.6					
1.40	21.1	15.3					
1.50	19.6	14.1					
1.60	25.6	17.6					
1.80	29.9	19.0					
2.00 (sampled)	30.8	18.3					
2.20	40.5	24.2					
2.40	42.8	25.7					
2.50	56.5	35.7					
3.00	72.1	48.8					
3.50	90.6	65.4					
4.00	114	77.6					

Table D-6. Jar Test Data, Run 17A

Chemical =	**PAM # 2 (Ciba Soilfix IR)**		
Date Run =	11/14/2004		
Water Source =	On-site Basin		
Time Run, Range =	8:30 - 10:30		
Mixing Condition =	Standard		Initial Temp (C) = 4.3
Jar Temp Range (C) =	5.5 - 8.1		
Jar pH Range (SU) =	7.2 - 7.3		
EC Range (uS) =	>4,000		

	Turbidity (NTU)			Turbidity (NTU)		Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0.00	155	153	0.00	153	153	158	156
0.25	75.5	60.0	0.25	109	71.7	75.3	55.7
0.30	52.7	44.0	0.50	67.8	43.5	46.1	38.1
0.40	46.1	36.6	0.75	88.5	48.3	34.4	29.5
0.50	41.8	33.6	1.00	88.7	45.9	38.0	25.7
0.60	45.6	48.5	1.25	82.9	42.4	49.5	32.9
0.70	47.7	36.2					
0.75	38.0	28.7					
0.80 (BTD)	34.7	28.3					
0.90	49.5	38.6					
1.00	42.1	33.6					
1.10	44.4	35.7					
1.20	55.1	34.7					
1.25	39.3	26.3					
1.30 (sampled)	48.5	31.1					
1.40	54.6	34.0					
1.50	86.4	55.4					
2.00	126	102					
2.50	139	137					
3.00	141	139					
3.50	142	139					
4.00	142	143					

Table D-7. Jar Test Data, Run 18

Chemical =	**PAX-XL9**
Date Run =	12/11/2004
Water Source =	HY89 + Ski Run
Time Run, Range =	16:00-19:00
Mixing Condition =	Standard, Mixing Sensitivity + Hot Jars (no cold)
Jar Temp Range (C) =	6.3- 7.4
Jar pH Range (SU) =	6.7 - 7.1
EC Range (uS) =	2,049-2,073

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0	188	183	25	190	181			
25	38.1	22.4	50	134	59.4	50	9.1	3.5
50 (sampled)	23.8	14.4	75	67.7	27.2	100	9.1	4.4
75	14.7	8.30	110	87.6	45.4			
100 (BTD)	13.3	8.25	125	110	50.3			
125	13.8	10.4	150	183	97.0		No Cold Jars Run	
150	21.1	15.9	175	186	100		(2 jars heated to 30 C)	
175	63.4	30.9	190	186	156			
200	173	116.0	200	184	178			
225	183	174.0	225	180	180			
250	185	177.0						
275	195	188.0						
300	192	176.0						
400	190	187						

Table D-8. Jar Test Data, Run 18

Chemical =	**PASS-C**
Date Run =	12/10/2004
Water Source =	HY89 + Ski Run
Time Run, Range =	13:00 - 15:00
Mixing Condition =	Standard, Mixing Sensitivity + Hot Jars (no cold)
Jar Temp Range (C) =	5.7 - 7.4
Jar pH Range (SU) =	5.3 - 7.0
EC Range (uS) =	2,151

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0	188	184	30	186	184			
25	191	186	40	180	120	50	13.4	9.6
30	187	183	50	143	65.6	125	5.0	2.3
40	67.3	40.7	100	65.6	35.2			
50	29.1	17.3	115	89.7	45.1			
75	17.3	8.6	125	165	71.6		No Cold Jars Run	
100 (BTD)	11.7	8.2	150	187	100		(2 jars heated to 30 C)	
125 (sampled)	14.0	9.6	175	187	132			
135	25.7	19.2	200	186	176			
150	46.1	28.2	225	186	180			
175	73.0	36.4	250	188	186			
190	141	60.2	275	196	187			
200	178	115						
250	193	173						
300	194	200						
400	203	199						

Table D-9. Jar Test Data, Run 18

Chemical =	**Sumalchlor 50**
Date Run =	12/10/2004
Water Source =	HY89 + Ski Run
Time Run, Range =	9:00 - 12:00
Mixing Condition =	Standard, Mixing Sensitivity + Hot Jars (no cold)
Jar Temp Range (C) =	4.4 - 7.2
Jar pH Range (SU) =	6.1 - 7.2
EC Range (uS) =	2,173

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0	186	178	0	189	187			
10	188	177	10	185	180	20	19.7	9.5
15	186	175	15	183	179	40	10.3	4.3
20	115	51.8	20	182	178			
25	65.8	29.6	25	182	106			
30	46.2	20.6	30	178	81.5		No Cold Jars Run	
35 (BTD)	47.1	19.8	35	178	74.8		(2 jars heated to 30 C)	
40	41.0	20.4	40	184	78.3			
50	36.1	19.9	50	188	146			
60	97.9	50.2	60	188	167			
70	180	149	70	194	187			
75	186	176	100	200	189			
100 (sampled)	194	194						
125	192	200						
150	187	195						
175	190	199						
200	192	204						
250	184	197						
300	194	192						
400	182	183						

Table D-10. Jar Test Data, Run 18

Chemical =	**JC 1720**
Date Run =	12/10/2004
Water Source =	HY89 + Ski Run
Time Run, Range =	16:00-18:00
Mixing Condition =	Standard, Mixing Sensitivity + Hot Jars (no cold)
Jar Temp Range (C) =	6.1 - 8.1
Jar pH Range (SU) =	6.2 - 7.1
EC Range (uS) =	2,060 - 2,097

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0	188	177	50	110.0	37.7			
25	160	109	70	96.7	34.8	50	4.8	3.2
50	33.9	11.4	80	90.2	35.4	150	4.7	3.2
60	24.4	11.4	90	92.7	39.1			
70	18.3	9.76	100	115	56.4		No Cold Jars Run	
80 (BTD)	15.3	8.71	110	180	104		(2 jars heated to 30 C)	
90	16.0	9.66	120	182	125			
100 (sampled)	16.2	9.06	130	183	120			
110	16.4	11.0	140	177	97.2			
120	20.3	14.7	150	170	99.3			
130	25.3	17.1	175	169	123			
140	30.0	20.6	200	183	92.2			
150	40.4	20.8						
175	48.5	23.4						
200	58.9	27.1						
250	114	56.9						
300	194	182						
400	193	190						

Table D-11. Jar Test Data, Run 18

Chemical =	**PAM #1 (Cytec A100)**
Date Run =	12/11/2004
Water Source =	HY89 + Ski Run
Time Run, Range =	12:00-18:00
Mixing Condition =	Standard, Mixing Sensitivity + Hot Jars (no cold)
Jar Temp Range (C) =	5.9 - 7.0
Jar pH Range (SU) =	7.2
EC Range (uS) =	2,015

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0.00	188	188	0.15	85.5	68.1			
0.15	73.5	60.9	0.25	66.4	52.3	0.50	24.0	20.7
0.25	56.8	46.2	0.35	63.9	46.3	1.00	33.8	25.9
0.35	47.2	38.9	0.50	60.7	42.0			
0.50 (BTD)	41.4	33.2	0.65	71.9	48.7		No Cold Jars Run	
0.65	45.6	33.9	0.75	79.4	55.4		(2 jars heated to 30 C)	
0.75	54.5	41.2	1.00	104	84.2			
1.00 (sampled)	76.2	56.7	1.15	106	89.5			
1.15	81.3	67.3	1.25	107	87.7			
1.25	87.2	70.5	1.50	110	106			
1.50	103	92.6	1.75	124	118			
1.70	121	105	2.00	137	121			
1.90	123	111						
2.00	124	112						
2.50	139	136						
3.00	146	146						
3.50	160	157						
4.00	161	156						

Table D-12. Jar Test Data, Run 18

Chemical =	**PAM # 2 (Ciba Soilfix IR)**
Date Run =	12/11/2004
Water Source =	HY89 + Ski Run
Time Run, Range =	8:00 - 12:00
Mixing Condition =	Standard, Mixing Sensitivity + Hot Jars (no cold)
Jar Temp Range (C) =	6.0 - 7.7
Jar pH Range (SU) =	7.3
EC Range (uS) =	2,056-2,060

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0.00	187	185	0.00	187	185			
0.05	74.5	66.8	0.05	148	132	0.20	48.3	38.9
0.10	63.3	58.0	0.10	126	107	1.00	91.9	77.8
0.20 (BTD)	65.5	55.2	0.20	112	97.2			
0.35	84.1	69.1	0.35	112	96.7			
0.50	85.7	69.0	0.50	126	106		No Cold Jars Run	
0.65	106	89.5	0.75	129	126		(2 jars heated to 30 C)	
0.75	97.7	86.0	1.00	145	134			
1.00 (sampled)	131	121	1.35	143	139			
1.15	142	128						
1.35	144	143						
1.50	170	157						
1.75	167	162						
2.00	166	160						
2.50	169	164						
3.00	174	163						

Table D-13. Jar Test Data, Run 19

Chemical =	**PAX-XL9**
Date Run =	12/18/2004
Water Source =	On-Site Basin
Time Run, Range =	12:00 - 14:00
Mixing Conditions =	Standard, Mixing Sensitivity & Cold Jars
Jar Temp Range (C) =	9.8 - 11.1
Jar pH Range (SU) =	6.3 - 7.4
EC Range (uS) =	1,980

Initial Temp (C) = 6.2

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0	803	772	25	302	102	25	49.7	31.3
10	449	444	50	115	38.2	50	29.9	19.0
20	153	101	75	70.4	29.1	75	27.2	19.2
25	47.9	27.5	100	56.5	26.1	100	27.6	20.4
40	30.0	16.1	125	57.7	27.3	125	45.9	40.4
50	30.0	15.2	150	93.5	52.1	150	105	93.2
80	40.2	11.4						
100 (BTD)	35.8	10.3						
120	35.1	12.4						
125	47.8	25.8						
140 (sampled)	48.3	35.1						
150	87.5	76.2						
175	184	149						
200	293	255						
250	658	535						
300	802	759						
400	826	870						

Table D-14. Jar Test Data, Run 19

Chemical =	**PASS-C**
Date Run =	12/16/2004
Water Source =	On-Site Basin
Time Run, Range =	14:45 - 18:00
Mixing Conditions =	Standard, Mixing Sensitivity & Cold Jars
Jar Temp Range (C) =	9.3 - 11.5
Jar pH Range (SU) =	5.1 - 7.2
EC Range (uS) =	1,833 - 1,925

Initial Temp (C) = 5.5

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0	815	735	50	150	63.8	50	74.6	36.2
10	754	622	75	106	40.1	75	62.7	23.8
20	99.1	65.6	100	90.1	39.1	100	67.1	24.1
25	34.6	24.4	125	87.7	46.2	125	33.9	26.9
30	44.4	21.9	150	158	85.7	150	48.3	39.8
40	26.4	16.4	175	480	179	175	202	145
50	27.8	15.2						
70	21.6	15.5						
75	22.1	13.4						
80	26.1	15.1						
90	21.3	15.0						
100 (BTD)	25.2	14.1						
110	21.9	14.3						
120	20.5	14.9						
125	26.1	22.3						
130 (sampled)	25.0	15.2						
150	52.2	45.8						
175	137	113						
200	247	216						
250	526	439						
300	720	605						
400	815	729						

Table D-15. Jar Test Data, Run 19

Chemical =	**Sumalchlor 50**
Date Run =	12/18/2004
Water Source =	On-Site Basin
Time Run, Range =	14:25 - 16:00
Mixing Condition =	Standard, Mixing Sensitivity & Cold Jars
Jar Temp Range (C) =	10.1 - 10.8
Jar pH Range (SU) =	7.0 - 7.1
EC Range (uS) =	1,890 - 2,043

Initial Temp (C) = 6.4

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0	818	739	10	214	95.7	10	178	133
10	495	482	20	156	72.6	20	79.0	23.0
20 (BTD)	60.6	29.4	30	163	80.4	30	55.7	16.9
25	50.2	31.2	40	301	127	40	42.7	16.7
30	66.5	35.0	50	500	201	50	40.0	17.7
40	74.2	52.6	60	588	360	60	94.0	45.1
50	196	140						
60	447	267						
75	496	312						
100 (sampled)	536	500						
125	537	525						
150	549	535						
175	559	547						
200	567	562						
250	572	567						
300	560	519						
400	568	545						

Table D-16. Jar Test Data, Run 19

Chemical =	**JC 1720**
Date Run =	12/17/2004
Water Source =	On-Site Basin
Time Run, Range =	12:00 - 14:00
Mixing Condition =	Standard, Mixing Sensitivity & Cold Jars
Jar Temp Range (C) =	10.1 - 11.6
Jar pH Range (SU) =	6.4 - 7.0
EC Range (uS) =	1,852 - 1,876

Initial Temp (C) = 5.5

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0	809	780	10	150	53.4	10	46.0	27.7
10	21.5	9.6	30	80.0	22.9	30	21.4	11.8
20	13.4	9.1	50	69.2	25.0	50	30.1	13.9
30 (BTD)	13.0	7.7	75	61.1	33.0	75	27.1	16.4
40	14.2	7.8	100	124	75.0	100	33.9	21.7
50	14.2	9.3	140	224	121	140	69.6	53.1
60	17.8	9.9						
70	18.0	13.4						
80	17.3	12.5						
90	17.1	12.6						
100 (sampled)	36.0	12.9						
120	22.6	16.9						
140	53.6	46.1						
150	375	332						
175	449	420						
200	511	496						
250	578	549						
300	687	668						
400	782	719						

Table D-17. Jar Test Data, Run 19

Chemical =	**PAM #1 (Cytec A100)**
Date Run =	12/17/2004
Water Source =	On-Site Basin
Time Run, Range =	9:00 - 13:40
Mixing Condition =	Standard, Mixing Sensitivity & Cold Jars
Jar Temp Range (C) =	9.4 - 10.4
Jar pH Range (SU) =	7.0
EC Range (uS) =	1,830 - 1,845

Initial Temp (C) = 4.9

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0.00	799	738	0.50	191	180	1.00	125	124
0.25	230	214	1.00	88.2	85.7	1.50	49.3	50.9
0.50	132	129	1.50	54.7	54.1	2.00	33.0	31.9
0.75	87.2	88.3	2.00	34.8	34.5	2.25	23.5	23.4
1.00	60.1	55.9	2.25	25.8	25.8	2.50	21.1	21.0
1.50	36.9	37.8	2.50	26.1	24.1	2.75	18.3	17.2
2.00	34.3	35.1	2.75	24.5	24.1	3.00	20.9	18.9
2.25	35.0	33.4	3.00	24.4	24.9	3.25	44.0	41.5
2.50	20.1	21.3	3.25	37.2	40.0	3.50	45.0	42.5
2.75 (BTD)	19.6	17.1	3.50	49.7	31.9	4.00	40.3	31.6
3.00	22.5	19.3						
3.50	64.9	32.8						
4.00 (sampled)	101	51.3						
5.00	103	38.2						
5.50	110	38.4						

Table D-18. Jar Test Data, Run 19

Chemical =	**PAM # 2 (Ciba Soilfix IR)**
Date Run =	12/18/2004
Water Source =	On-Site Basin
Time Run, Range =	9:10 - 10:45
Mixing Condition =	Standard, Mixing Sensitivity & Cold Jars — Initial Temp (C) = 5.6
Jar Temp Range (C) =	8.9 - 10.0
Jar pH Range (SU) =	7.1 - 7.2
EC Range (uS) =	1,834 - 1,868

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0.00	785	790	0.50	151	135	0.50	125	123
0.20	228	219	0.75	137	102	0.75	95.4	89.7
0.40	141	136	1.00	81.2	77.6	1.00	79.9	71.4
0.60	111	105	1.25	82.2	67.5	1.25	71.5	59.3
0.80	85.8	83.2	1.50	67.4	56.5	1.50	68.3	55.2
1.00	77.4	72.5	2.00	89.6	60.7	2.00	78.9	51.3
1.20	64.6	60.2						
1.40	51.4	49.9						
1.60 (BTD)	55.1	48.1						
1.80	67.0	49.8						
2.00 (sampled)	88.4	75.5						
2.50	109	95.1						
3.00	194	149						
3.50	259	196						
4.00	348	253						

Table D-19. Jar Test Data, Run 20

Chemical =	**PAX-XL9**
Date Run =	3/12/2005
Water Source =	On-Site Basin
Time Run, Range =	11:15 - 14:00
Mixing Conditions =	Standard, Mixing Sensitivity (no "Cold Jars" because initial temperature < 5 C) — Initial Temp (C) = 4.4
Jar Temp Range (C) =	4.4-9.1
Jar pH Range (SU) =	6.2 - 7.4
EC Range (uS) =	2,865-2,950

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0	1690	1610	50	86.5	26.4			
25	57.0	41.1	100	32.2	14.0			
50	36.7	8.5	150	29.7	12.2		Not Run	
75	12.7	3.5	200	24.6	13.8			
100 (sampled)	6.9	2.9	250	27.6	13.7			
125	6.7	3.4	300	29.9	20.4			
150	10.4	3.2						
175	15.1	7.5						
190	6.8	3.5						
200	6.7	2.7						
220	7.9	4.8						
250	5.6	2.2						
260	10.1	5.6						
270	6.4	3.8						
280	7.5	3.9						
290 (BTD)	5.0	2.1						
300	13.3	8.3						
320	14.5	9.6						
400	33.6	20.8						
450	86.5	65.4						
500	211	168						

Table D-20. Jar Test Data, Run 20

Chemical =	**PASS-C**
Date Run =	3/13/2005
Water Source =	On-Site Basin
Time Run, Range =	14:45 - 16:45
Mixing Conditions =	Standard, Mixing Sensitivity (no "Cold Jars" because initial temperature < 5 C) — Initial Temp (C) = 5.0
Jar Temp Range (C) =	5.0-6.9
Jar pH Range (SU) =	6.0-7.0
EC Range (uS) =	2,849-2,940

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0	1744	1649	50	65.1	34.6			
25	91.0	59.9	100	45.2	19.1			
50	28.5	10.3	150	32.6	14.7		Not Run	
75	25.3	11.6	200	35.9	17.0			
100 (sampled)	19.0	10.5	250	24.0	12.5			
110 (BTD)	14.1	5.1	300	21.8	12.3			
120	20.6	6.7	400	35.9	31.9			
125	19.8	11.3	500	245	206			
130	16.3	7.2						
140	20.1	7.9						
150	18.5	8.1						
160	20.4	11.7						
170	21.3	11.6						
180	19.8	9.6						
190	20.1	9.3						
200	20.7	9.8						
250	19.5	10.1						
300	25.4	12.5						
400	32.8	18.4						
450	144	127						
500	347	301						

Table D-21. Jar Test Data, Run 20

Chemical =	**Sumalchlor 50**
Date Run =	3/13/2005
Water Source =	On-Site Basin
Time Run, Range =	11:00 - 14:00
Mixing Condition =	Standard, Mixing Sensitivity (no "Cold Jars" because initial temperature < 5 C) — Initial Temp (C) = 5.0
Jar Temp Range (C) =	5.0 - 8.4
Jar pH Range (SU) =	6.8 - 7.5
EC Range (uS) =	2,870 - 2,923

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0	1694	1686	25	48.9	22.5			
25	86.8	18.0	50	33.8	14.8			
35	22.7	9.1	75	35.0	18.7		Not Run	
40	25.4	8.5	100	42.1	23.6			
45 (BTD)	15.8	5.2	150	325	84.6			
50	43.8	9.7	200	1419	318			
55	23.3	8.7						
60	31.0	13.8						
65	44.6	11.4						
70	58.6	15.6						
75	33.3	13.2						
80	23.8	9.91						
85	26.6	9.82						
90 (sampled)	54.3	11.9						
100	30.1	11.1						
125	28.5	11.3						
150	86.4	67.0						
175	311	289						
200	561	524						
250	1780	1561						
300	1852	1780						
400	1811	1795						

Table D-22. Jar Test Data, Run 20

Chemical =	**JC 1720**	
Date Run =	3/12/2005	
Water Source =	On-Site Basin	
Time Run, Range =	8:55 - 10:00	
Mixing Condition =	Standard, Mixing Sensitivity (no "Cold Jars" because initial temperature < 5 C)	Initial Temp (C) = 4.2
Jar Temp Range (C) =	4.2 - 7.4	
Jar pH Range (SU) =	6.2 - 7.2	
EC Range (uS) =	2,899 - 2,943	

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0	1,664	1,568	50	42.7	12.3			
25	17.1	6.1	100	36.6	16.2			
50	12.1	5.0	150	24.9	17.4		Not Run	
75	9.4	4.3	200	18.5	11.7			
100 (sampled)	8.3	3.6	250	21.0	13.5			
125	12.2	4.1	300	53.6	18.2			
150	8.0	7.6						
175	16.4	4.9						
200	9.6	4.2						
210	17.8	3.5						
220	12.1	4.8						
230	11.1	4.8						
240 (BTD)	8.3	3.3						
250	6.1	3.4						
260	14.2	5.0						
270	7.2	3.8						
280	10.9	3.32						
300	8.8	4.9						
400	28.3	15.5						
500	93.5	71.5						

Table D-23. Jar Test Data, Run 20

Chemical = **PAM #1 (Cytec A100)**
Date Run = 3/12/2005
Water Source = On-Site Basin
Time Run, Range = 12:00 - 17:15
Mixing Condition = Standard, Mixing Sensitivity (no "Cold Jars" because initial temperature < 5 C) Initial Temp (C) = 5.0
Jar Temp Range (C) = 5.0 - 8.3
Jar pH Range (SU) = 7.0 - 7.2
EC Range (uS) = 2,834 - 2,859

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0.00	1699	1624	1.00	600	530			
0.25	1343	1254	2.00	272	265			
0.50	999	926	4.00	109	107		Not Run	
0.75	773	727	6.00	41.5	42.2			
1.00	605	561	8.00	41.2	41.2			
1.25	477	473	10.00	73.2	71.6			
1.50	413	406						
2.00	311	310						
2.50	228	228						
3.00	178	179						
3.50	137	133						
4.00	105	103						
4.50	89.7	90.4						
5.00	73.7	73.4						
5.50	58.0	57.3						
6.00	43.7	42.5						
6.50	39.5	37.6						
7.00	31.3	30.4						
7.50	26.1	24.3						
8.00	21.2	20.6						
8.50	22.3	18.3						
9.00	13.9	12.0						
10.0 (BTD)	12.0	11.2						
11.0	14.2	12.7						
12.0	19.4	14.4						
13.0 (sampled)	23.2	12.2						
15.0	28.3	16.9						

Table D-24. Jar Test Data, Run 20

Chemical =	**PAM # 2 (Ciba Soilfix IR)**
Date Run =	3/13/2005
Water Source =	On-Site Basin
Time Run, Range =	9:00 - 11:00
Mixing Condition =	Standard, Mixing Sensitivity (no "Cold Jars" because initial temperature < 5 C) — Initial Temp (C) = 5.0
Jar Temp Range (C) =	4.0 - 8.5
Jar pH Range (SU) =	7.3 - 7.4
EC Range (uS) =	2,853 - 2,886

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0.00	1698	1637	1.00	346	332			
0.25	700	692	2.00	163	161			
0.50	605	594	4.00	98.3	78.8		Not Run	
0.75	489	466	6.00	69.3	48.9			
1.00	392	385	8.00	68.1	46.2			
1.50	268	267	10.00	136	62.1			
2.00	200	198						
2.50	138	137						
3.00	111	109						
3.50	104	99.3						
4.00	85.6	79.3						
4.50	65.9	62.1						
5.00	63.0	58.6						
5.50	36.8	38.2						
6.00	34.2	31.6						
6.50	39.9	32.2						
7.00 (BTD)	38.2	21.2						
7.50	43.7	33.5						
8.00	47.3	31.4						
8.50	46.3	32.2						
9.00	54.9	32.8						
9.50	68.4	38.0						
10.0 (sampled)	70.5	40.8						

Table D-25. Jar Test Data, Run 21

Chemical =	**PAX-XL9**
Date Run =	3/20/2005
Water Source =	HY89+AlTahoe+Ski Run
Time Run, Range =	10:00 - 3:00
Mixing Conditions =	Standard, Mixing Sensitivity (No Cold Jars, <5C)
Jar Temp Range (C) =	3.2 - 5.6
Jar pH Range (SU) =	5.7 - 7.0
EC Range (uS) =	662 - 743

Initial Temp (C) = 3.2

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0	241	233	90	79.7	25.5			
25	265	238	100	67.9	20.5			
50	33.0	14.4	110	69.8	28.5		Not Run	
60	18.0	9.8	120	46.6	20.4			
70	20.7	10.0	130	49.0	22.9			
75	21.1	9.8	140	45.6	20.4			
80	15.9	8.5						
90 (BTD)	12.0	5.9						
100 (sampled)	13.1	6.6						
110	11.1	7.3						
120	12.2	7.6						
125	14.0	8.1						
130	16.1	9.1						
140	12.8	8.3						
150	14.4	8.8						
160	15.8	8.0						
170	14.3	9.2						
175	16.8	10.1						
200	19.7	11.8						
250	157	126						
300	206	158						
400	254	232						

Table D-26. Jar Test Data, Run 21

Chemical =	**PASS-C**
Date Run =	3/21/2005
Water Source =	HY89+AlTahoe+Ski Run
Time Run, Range =	10:00 - 12:30
Mixing Conditions =	Standard, Mixing Sensitivity (No Cold Jars, <5C) — Initial Temp (C) = 3.1
Jar Temp Range (C) =	3.1 - 8.3
Jar pH Range (SU) =	5.4 - 7.4
EC Range (uS) =	651- 721

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0	249	241	20	237	133			
20 (sampled)	77.8	57.4	70	127	23.8			
25	28.0	17.6	80	158	32.2		Not Run	
50	17.6	8.7	90	136	26.3			
70	18.1	8.7	100	135	21.7			
75	18.8	8.4	140	195	23.3			
80	13.2	7.4						
90	18.2	8.9						
100 (BTD)	16.2	7.1						
125	10.9	7.2						
140	25.2	17.0						
150	54.2	20.0						
175	146	30.1						
200	166	118						
250	205	165						
300	237	213						
400	228	228						

Table D-27. Jar Test Data, Run 21

Chemical =	**Sumalchlor 50**	
Date Run =	3/24/2005	
Water Source =	HY89+AlTahoe+Ski Run	
Time Run, Range =	2:!5 - 4:30	
Mixing Condition =	Standard, Mixing Sensitivity (No Cold Jars, <5C)	Initial Temp (C) = 5.2
Jar Temp Range (C) =	5.2 - 7.9	
Jar pH Range (SU) =	6.2 - 7.2	
EC Range (uS) =	631 - 672	

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0	250	241	10	115	43.0			
5	34.5	16.3	20	84.2	37.1			
10	33.1	17.8	30	87.4	41.2		Not Run	
15	23.8	14.3	40	226	62.0			
20	28.6	13.3	60	229	69.2			
25 (BTD)	18.4	11.0	100	256	246			
30	30.6	13.7						
35	25.2	12.6						
40	25.1	13.4						
45	20.4	12.5						
50	42.2	26.1						
50	33.2	18.7						
55	45.6	32.1						
75	254	237						
100 (sampled)	241	237						
125	270	244						
150	282	251						
175	264	231						
200	266	243						
250	263	231						
300	282	232						
400	270	231						

Table D-28. Jar Test Data, Run 21

Chemical =	**JC 1720**
Date Run =	3/20/2005
Water Source =	HY89+AlTahoe+Ski Run
Time Run, Range =	9:40 - 11:30
Mixing Condition =	Standard, Mixing Sensitivity (No Cold Jars, <5C)
Jar Temp Range (C) =	3.2 - 5.9
Jar pH Range (SU) =	5.6 - 7.1
EC Range (uS) =	652 - 714

Initial Temp (C) = 3.2

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0	258	246	60	62	23.4			
25	252	221	70	64.4	18.3			
50	25.1	10.8	80	60.3	24.7		Not Run	
60 (sampled)	11.1	7.6	90	65.1	25.4			
70	25.8	7.8	100	167	56.6			
75	14.1	7.5	110	221	69.9			
80	17.3	13.6						
90	12.8	8.4						
100 (BTD)	13.2	7.4						
110	39.6	18.5						
125	39.9	21.5						
150	126	83.2						
175	138	95.9						
200	162	110						
250	208	173						
300	226	202						
400	253	231						

Table D-29. Jar Test Data, Run 21

Chemical =	**PAM #1 (Cytec A100)**
Date Run =	3/20/2005
Water Source =	HY89+AlTahoe+Ski Run
Time Run, Range =	14:30 - 17:00
Mixing Condition =	Standard, Mixing Sensitivity (No Cold Jars, <5C)
Jar Temp Range (C) =	3.2 - 6.1
Jar pH Range (SU) =	7.3 - 7.5
EC Range (uS) =	636 -640

Initial Temp (C) = 3.2

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0.00	261	236	0.15	70.9	53.0			
0.05	65.9	52.9	0.20	79.7	62.8			
0.10	66.6	42.3	0.25	97.2	69.3		Not Run	
0.15	41.1	39.2	0.30	107	79.0			
0.20	39.3	36.3	0.35	112	89.2			
0.25	37.3	35.5	0.40	118	97.3			
0.30	39.3	36.6						
0.35 (BTD)	42.8	35.3						
0.40	48.4	38.2						
0.45	53.7	48.0						
0.50	60.3	51.4						
0.55	71.5	55.6						
0.60 (sampled)	83.0	69.1						
0.75	96.2	74.2						
1.00	110	88.3						
1.25	167	130						
1.50	206	166						
2.00	225	194						
2.50	226	210						
3.00	221	202						
3.50	222	206						
4.00	236	210						

Table D-30. Jar Test Data, Run 21

Chemical =	**PAM # 2 (Ciba Soilfix IR)**
Date Run =	3/21/2005
Water Source =	HY89+AlTahoe+Ski Run
Time Run, Range =	13:30 - 16:00
Mixing Condition =	Standard, Mixing Sensitivity (No Cold Jars, <5C)
Jar Temp Range (C) =	5.1 - 7.0
Jar pH Range (SU) =	7.3-7.4
EC Range (uS) =	646 - 650

Initial Temp (C) = 3.9

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0.00	244	238	0.10	126	104			
0.05	91.4	77.8	0.20	153	120			
0.10 (BTD)	78.5	67.6	0.30	169	143		Not run	
0.15	84.5	69.4	0.50	181	174			
0.20	98.2	80.1	0.75	208	193			
0.25	108	86.6	1.00	215	200			
0.30	116	97.3						
0.35	121	93.8						
0.40	120	98.3						
0.45	132	102						
0.50	131	106						
0.50	129	105						
0.75	163	132						
1.00 (sampled)	203	166						
1.25	216	183						
1.50	223	184						
2.00	235	201						
2.50	223	214						
3.00	233	213						
3.50	227	223						
4.00	240	218						

Table D-31. Jar Test Data, Run 22

Chemical =	**PAX-XL9**
Date Run =	4/23/2005
Water Source =	On-Site Basin Snow Melt
Time Run, Range =	8:15 - 11:20
Mixing Conditions =	Standard, Mixing and Temperature Sensitivity
Jar Temp Range (C) =	7.4 - 9.6
Jar pH Range (SU) =	5.5 - 7.4
EC Range (uS) =	>4000

Initial Temp (C) = 2.6

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0	389	371	25	146	66.4	25	49.3	25.2
25	28.3	16.3	50	52.8	27.1	50	43.6	12.3
50	10.8	6.8	100	73.3	32.3	100	13.9	10.6
75	9.5	5.6	150	117	45.0	150	15.9	12.2
100 (sampled)	10.6	6.2	200	135	70.0	200	33.9	30.1
125 (BTD)	8.9	6.4	250	301	103	250	97.7	83.6
150	13.0	9.3						
175	18.0	15.2						
200	26.7	24.3						
250	118	61.4						
300	255	222						
400	415	415						

Table D-32. Jar Test Data, Run 22

Chemical =	**PASS-C**
Date Run =	4/28/2005
Water Source =	On-Site Basin Snow Melt
Time Run, Range =	3:00 - 6:00 pm
Mixing Conditions =	Standard, Mixing and Temperature Sensitivity
Jar Temp Range (C) =	11.9 - 13.0
Jar pH Range (SU) =	5.2 - 7.4
EC Range (uS) =	3,586 - 3,679

Initial Temp (C) = 4.8

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0	400	369	25	47.5	21.9	25	15.4	9.9
25 (sampled)	30.1	21.8	75	28.0	20.4	75	15.0	12.6
50	17.6	5.1	125	40.2	30.4	125	35.6	24.4
75	13.9	5.9	175	91.2	37.7	175	91.7	64.8
100 (BTD)	7.9	4.3	250	267	196	250	213	170
125	12.2	4.4	400	441	382	400	407	334
150	12.6	4.6						
175	11.3	5.5						
200	10.4	6.6						
250	11.9	9.0						
300	76.5	27.0						
400	324	262						

Table D-33. Jar Test Data, Run 22

Chemical =	**Sumalchlor 50**
Date Run =	4/24/2005
Water Source =	On-Site Basin Snow Melt
Time Run, Range =	9:30 am - 3:30 pm
Mixing Condition =	Standard, Mixing and Temperature Sensitivity
Jar Temp Range (C) =	7.2 - 10.4
Jar pH Range (SU) =	6.3 - 7.4
EC Range (uS) =	>4,000

Initial Temp (C) = 0.9

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0	379	373	10	237	90.8	10	60.0	23.0
10	44.9	23.1	20	109	49.6	20	28.7	15.9
20	28.6	13.5	30	89.8	46.5	30	29.7	15.1
30 (BTD)	29	12.1	50	124	62.3	50	43.8	26.8
40	30.1	13.9	75	335	127	75	175	131
50	31.2	17.3	100	390	142	100	397	282
60	37.6	21.4						
70	57.9	30.0						
80	59.3	43.0						
90	81.8	63.7						
100 (sampled)	112	87.7						
125	335	222						
150	394	390						
175	407	390						
200	403	404						
250	431	408						
300	404	410						
400	397	402						

Table D-34. Jar Test Data, Run 22

Chemical =	**JC 1720**
Date Run =	4/22/2005
Water Source =	On-Site Basin Snow Melt
Time Run, Range =	9:00 - 11:30
Mixing Condition =	Standard, Mixing and Temperature Sensitivity
Jar Temp Range (C) =	7.2 - 9.8
Jar pH Range (SU) =	5.7 - 7.4
EC Range (uS) =	3,933 - >4,000

Initial Temp (C) = 2.6

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0	398	379	25	73.0	23.0	25	16.0	9.2
25	13.1	7.0	50	70.6	22.1	50	15.4	6.0
50	8.1	4.9	100	43.5	21.3	100	13.5	6.4
75	11.5	5.9	150	49.7	26.3	150	8.7	6.7
100 (sampled)	9.3	5.5	200	32.0	22.5	200	17.8	12.0
125	7.9	5.7	300	254	40.9	300	58.5	60.8
150	7.2	4.8						
175 (BTD)	6.0	3.9						
200	7.1	4.2						
250	12.1	8.7						
300	65.6	30.6						
400	198	176						

Table D-35. Jar Test Data, Run 22

Chemical =	**PAM #1 (Cytec A100)**
Date Run =	4/23/2005
Water Source =	On-Site Basin Snow Melt
Time Run, Range =	10:30 - 13:30
Mixing Condition =	Standard, Mixing and Temperature Sensitivity
Jar Temp Range (C) =	7.5 - 10.1
Jar pH Range (SU) =	7.5
EC Range (uS) =	>4,000

Initial Temp (C) = 3.9

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0.00	373	371	0.50	185	138	0.50	126	112
0.25	237	225	1.00	87.6	69.9	1.00	62.1	55.0
0.50	138	123	2.00	36.6	25.1	2.00	22.8	20.4
0.75	94.1	85.4	4.00	44.5	19.9	4.00	19.4	13.4
1.00	63.8	63.5	6.00	130	60.6	6.00	70.6	53.0
1.25	52.1	52.6	8.00	199	89.0	8.00	113	85.8
1.50	39.9	39.2						
2.00	27.5	24.4						
2.50	22.3	19.6						
3.00	15.4	14.4						
3.50	11.2	11.3						
4.00 (BTD)	9.1	8.7						
5.00	33.2	18.4						
6.00	71.6	37.5						
7.00	97.3	47.0						
8.00 (sampled)	133	68.3						
9.00	161	85.7						
10.00	205	109						

Table D-36. Jar Test Data, Run 22

Chemical =	**PAM # 2 (Ciba Soilfix IR)**	
Date Run =	4/23/2005	
Water Source =	On-Site Basin Snow Melt	
Time Run, Range =	13:30 - 15:00	
Mixing Condition =	Standard, Mixing and Temperature Sensitivity	Initial Temp (C) = 3.9
Jar Temp Range (C) =	7.3 - 10.1	
Jar pH Range (SU) =	7.6 - 7.6	
EC Range (uS) =	>4,000	

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0.00	358	373	0.50	129	114	0.50	101	104
0.25	177	176	1.00	77.9	64.9	1.00	60.6	59.5
0.50	110	111	1.50	66.0	50.4	1.50	41.6	38.2
0.75	79.6	77.4	2.00	67.7	42.3	3.00	41.9	37.8
1.00	61.2	65.2	3.00	97.8	62.9	4.00	131	84.3
1.25	52.0	51.4	4.00	187	86.0			
1.50	46.1	44.7						
2.00	37.7	34.1						
2.50 (BTD)	43.3	33.6						
3.00	38.2	35.6						
3.50	54.1	59.9						
4.00 (sampled)	95.3	80.2						
5.00	138	121						
6.00	164	155						
7.00	201	192						
8.00	247	220						
9.00	315	261						
10.00	370	288						

Table D-37. Jar Test Data, Run 23

Chemical =	**PAX-XL9**	
Date Run =	4/30/2005	
Water Source =	HY-89 Rain Event	
Time Run, Range =	10:20 - 15:00	
Mixing Conditions =	Standard, Mixing and Temperature Sensitivity	Initial Temp (C) = 3.3
Jar Temp Range (C) =	10.0 - 10.5	
Jar pH Range (SU) =	6.4 - 7.5	
EC Range (uS) =	637 - 697	

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0	257	247	100	50.3	16.2	100	29.4	4.7
25	254	241	200	17.0	7.5	200	5.1	2.1
50	251	243	300	11.7	5.8	300	3.0	1.2
75	154	124	400	15.6	8.3	400	1.4	0.95
100 (sampled)	30.3	11.5	500	24.4	13.0	500	6.9	5.2
125	29.9	5.67	600	253	225	600	210	177
150	6.34	3.75						
175	7.59	3.42						
200	5.13	3.75						
250 (BTD)	6.37	2.48						
300	6.84	5.53						
400	15.0	3.00						
425	6.43	2.98						
450	6.98	3.24						
475	7.70	2.99						
500	7.60	3.45						
525	9.23	4.06						
550	24.7	10.5						
575	210	196						
600	236	230						
650	273	253						

Table D-38. Jar Test Data, Run 23

Chemical =	**PASS-C**
Date Run =	4/30/2005
Water Source =	HY-89 Rain Event
Time Run, Range =	12:00 - 4:00
Mixing Conditions =	Standard, Mixing and Temperature Sensitivity
Jar Temp Range (C) =	10.0 - 11.0
Jar pH Range (SU) =	6.5 - 7.5
EC Range (uS) =	621 - 683

Initial Temp (C) = 3.4

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0	249	243	100	46.9	22.5	100	18.3	9.4
25	256	228	200	21.0	8.4	200	37.3	5.5
50	15.2	13.3	300	12.9	5.8	300	5.9	4.3
75	5.35	3.90	400	9.7	5.2	400	8.4	4.6
100 (sampled)	6.02	3.15	500	18.3	9.2	500	17.0	10.6
125	3.62	2.27	600	246	147	600	224	162
150	17.6	4.41						
175	15.2	4.27						
200	20.0	4.34						
250	4.60	2.34						
300	5.20	2.22						
400 (BTD)	4.30	2.01						
425	4.04	2.42						
450	4.63	2.48						
475	5.36	2.76						
500	7.29	4.15						
550	12.0	7.23						
600	117	31.9						
650	212	201						
700	235	221						

Table D-39. Jar Test Data, Run 23

Chemical =	**Sumalchlor 50**							
Date Run =	5/1/2005							
Water Source =	HY-89 Rain Event							
Time Run, Range =	8:30 - 12;00							
Mixing Condition =	Standard, Mixing and Temperature Sensitivity						Initial Temp (C) = 0.8	
Jar Temp Range (C) =	10.0 - 11.6							
Jar pH Range (SU) =	6.9 - 7.6							
EC Range (uS) =	626 - 667							

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0	258	250	25	256	227	25	27.8	10.2
25	245	234	50	70.8	35.8	50	19.2	6.5
50	61.8	37.2	75	52.6	12.0	75	105	26.0
75	41.7	17.9	100	188	17.9	100	267	94.9
100 (sampled)	16.1	6.2	150	271	41.3	150	265	225
110	16.0	6.7	200	270	244	200	286	243
120	21.8	6.5						
130 (BTD)	7.6	4.7						
140	11.7	5.3						
150	15.5	10.7						
175	11.2	6.1						
200	12.0	5.6						
250	62.2	24.2						
300	270	267						
400	262	260						

Table D-40. Jar Test Data, Run 23

Chemical =	**JC 1720**
Date Run =	4/30/2005
Water Source =	HY-89 Rain Event
Time Run, Range =	9:00 - 15:00
Mixing Condition =	Standard, Mixing and Temperature Sensitivity
Jar Temp Range (C) =	10.0 - 10.9
Jar pH Range (SU) =	6.6 - 7.7
EC Range (uS) =	655 - 1,028

Initial Temp (C) = 3.3

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0	266	240	100	21.3	10.9	100	10.5	2.3
25	251	235	200	17.6	5.7	200	30.1	1.5
50	124	101	300	16.1	11.2	300	9.8	3.2
75	11.3	7.02	400	49.7	18.0	400	5.7	4.0
100 (sampled)	24.4	9.31	500	290	68.0	500	9.3	6.5
125	29.7	5.41	600	264	236	600	150	150
150	6.25	3.73						
175	5.67	3.26						
200 (BTD)	3.38	2.46						
250	6.82	2.76						
300	4.46	3.54						
400	4.85	4.10						
450	6.16	3.32						
500	6.75	3.92						
550	37.4	16.2						
600	234	233						
650	212	198						

Table D-41. Jar Test Data, Run 23

Chemical =	**PAM #1 (Cytec A100)**
Date Run =	5/1/2005
Water Source =	HY-89 Rain Event
Time Run, Range =	11:15 - 14:00
Mixing Condition =	Standard, Mixing and Temperature Sensitivity
Initial Temp (C) =	2.5
Jar Temp Range (C) =	10.1 - 11.0
Jar pH Range (SU) =	7.4 - 7.5
EC Range (uS) =	628 - 695

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0.00	246	240	0.25	44.3	41.4	0.25	38.4	35.7
0.25	60.1	57.4	0.50	33.9	29.0	0.50	30.1	26.1
0.50	42.4	41.4	0.75	35.2	28.8	0.75	26.6	22.7
0.75	23.9	23.6	1.00	34.4	26.6	1.00	27.0	22.5
1.00 (BTD)	22.6	20.5	2.00	93.4	74.4	2.00	87.1	63.0
1.25	28.2	23.4	3.00	222	167	3.00	205	152
1.50	30.9	25.4						
2.00	59.8	44.9						
2.50	121	92.2						
3.00 (sampled)	186	140						
3.50	192	139						
4.00	221	176						

Table D-42. Jar Test Data, Run 23

Chemical =	**PAM # 2 (Ciba Soilfix IR)**							
Date Run =	5/1/2005							
Water Source =	HY-89 Rain Event							
Time Run, Range =	10:30 - 13:30							
Mixing Condition =	Standard, Mixing and Temperature Sensitivity						Initial Temp (C) = 2.5	
Jar Temp Range (C) =	9.9 - 10.1							
Jar pH Range (SU) =	7.7 - 7.8							
EC Range (uS) =	618 - 630							

	Turbidity (NTU)			Turbidity (NTU)			Turbidity (NTU)	
Dose (mg/L as product)	Standard Mixing, 15 min.	Standard Mixing, 1 hr.	Dose (mg/L)	Mixing Sensitivity, 15 min.	Mixing Sensitivity, 1 hr.	Dose (mg/L)	Temp Sensitivity, 15 min.	Temp Sensitivity, 1 hr.
0.00	231	232	0.25	95.8	79.6	0.25	46.8	45.0
0.10	92.0	84.1	0.50	95.0	75.9	0.50	51.7	45.5
0.20	70.8	65.2	0.75	96.0	75.4	0.75	59.7	52.5
0.25	58.3	54.3	1.00	85.0	72.3	1.00	77.3	64.2
0.30	59.8	56.8	2.00	180	164	2.00	192	164
0.40	56.9	51.6	3.00	201	187	3.00	216	196
0.50 (BTD)	43.6	42.9						
0.60	55.2	47.4						
0.75	48.4	44.4						
1.00	67.4	55.9						
1.25	89.7	80.3						
1.50	124	108						
2.00 (sampled)	160	152						
2.50	156	151						
3.00	199	204						
3.50	226	218						
4.00	217	217						

Table D-43. Phase IV Jar Test Phosphorus Data

Regular (100 mg/L, excess, etc.)								
Chemical	Log Number	Dose (mg/L)	Q	R	Phos-T (mg-P/L)	Q	R	Phos-D (mg-P/L)
PASS-C								
	17A-PS-100	100			< 0.03			< 0.03
	18-PS-125	125			0.32			< 0.03
	19-PS-130	130			< 0.03			< 0.03
	20-PC-100	100			< 0.03			< 0.03
	21-PC-100	20			0.12			< 0.03
	22-PC-25	25			0.16			< 0.03
	23-PC-100	100			0.15			< 0.03
PAX-XL9								
	17A-PX-100	100			0.04			< 0.03
	18-PX-50	50			< 0.03			< 0.03
	19-PX-EX	140			< 0.03			< 0.03
	20-PX-100	100			< 0.03			< 0.03
	21-PX-100	100			< 0.03			< 0.03
	22-PX-100	100			< 0.03			< 0.03
	23-PX-100	100			0.15			< 0.03
JC 1720								
	17A-JC-100	100			< 0.03			< 0.03
	18-JC-100	100			< 0.03			< 0.03
	19-JC-100	100			< 0.03			< 0.03
	20-JC-100	100			< 0.03			< 0.03
	21-JC-100	60			< 0.03			< 0.03
	22-JC-100	100			< 0.03			< 0.03
	23-JC-100	100			1.66			0.16

Best Turbidity Dose (BTD)								
Chemical	Log Number	Dose (mg/L)	Q	R	Phos-T (mg-P/L)	Q	R	Phos-D (mg-P/L)
PASS-C								
	17A-PS-BTD	50			< 0.03			< 0.03
	18-PS-100	100			< 0.03			< 0.03
	19-PS-BTD	100			< 0.03			< 0.03
	20-PC-BTD	110			< 0.03			< 0.03
	21-PC-BTD	100			< 0.03			< 0.03
	22-PC-BTD	100			0.15			< 0.03
	23-PC-BTD	400			0.14			< 0.03
PAX-XL9								
	17A-PX-BTD	70			< 0.03			< 0.03
	18-PX-100	100			< 0.03			< 0.03
	19-PX-BTD	100			< 0.03			< 0.03
	20-PX-BTD	290			< 0.03			< 0.03
	21-PX-BTD	90			< 0.03			< 0.03
	22-PX-BTD	125			< 0.03			< 0.03
	23-PX-BTD	250			0.16			< 0.03
JC 1720								
	17A-JC-BTD	120			< 0.03			< 0.03
	18-JC-BTD	70			< 0.03			< 0.03
	19-JC-BTD	30			< 0.03			< 0.03
	20-JC-BTD	240			< 0.03			< 0.03
	21-JC-BTD	100			< 0.03			< 0.03
	22-JC-BTD	175			< 0.03			< 0.03
	23-JC-BTD	200			0.14			< 0.03

Table D-43. Phase IV Jar Test Phosphorus Data Continued

Regular (100 mg/L, excess, etc.)									Best Turbidity Dose (BTD)								
Chemical	Log Number	Dose (mg/L)	Q	R	Phos-T (mg-P/L)	Q	R	Phos-D (mg-P/L)	Chemical	Log Number	Dose (mg/L)	Q	R	Phos-T (mg-P/L)	Q	R	Phos-D (mg-P/L)
Sumalchlor 50									**Sumalchlor 50**								
	17A-SR-100	100			0.11			0.03		17A-SR-BTD	25			0.03			< 0.03
	18-SR-100	100			0.46			0.03		18-SR-BTD	35			< 0.03			< 0.03
	19-SC-100	100			0.17			< 0.03		19-SC-BTD	20			< 0.03			< 0.03
	20-SC-100	100			< 0.03			< 0.03		20-SC-BTD	45			< 0.03			< 0.03
	21-SC-100	100			0.48			< 0.03		21-SC-BTD	25			< 0.03			< 0.03
	22-SC-100	100			0.11			< 0.03		22-SC-BTD	30			< 0.03			< 0.03
	23-SC-100	100			0.14			< 0.03		23-SC-BTD	130			0.14			< 0.03
PAM 1									**PAM 1**								
(A-100)	17A-P1-EX	2.00			< 0.03			< 0.03	(A-100)	17A-P1-BTD	1.20			< 0.03			< 0.03
	18-P1-EX	1.00			< 0.03			< 0.03		18-P1-BTD	0.50			< 0.03			< 0.03
	19-P1-EX (4.0)	4.00			< 0.03			< 0.03		19-P1-BTD (2.75)	2.75			< 0.03			< 0.03
	20-PM1-EX	13.00			0.08			0.06		20-PM1-BTD	10.00			< 0.03			< 0.03
	21-PM1-EX	0.60			0.11			< 0.03		21-PM1-BTD	0.35			0.06			< 0.03
	22-PM1-EX	8.00			0.18			0.07		22-PM1-BTD	4.00			0.11			0.08
	23-PM1-EX	8.00			0.37			0.19		23-PM1-BTD	1.00			0.35			0.19
PAM 2									**PAM 2**								
(SoilFix)	17A-P2-EX	1.30			0.03			< 0.03	(SoilFix)	17A-P2-BTD	0.80			0.03			< 0.03
	18-P2-EX	1.00			0.17			< 0.03		18-P2-BTD	0.20			< 0.03			< 0.03
	19-P2-EX	2.00			< 0.03			< 0.03		19-P2-BTD	1.60			< 0.03			< 0.03
	20-PM2-EX	10.00			0.09			0.07		20-PM2-BTD	7.00			0.09			0.07
	21-PM2-EX	1.00			0.31			< 0.03		21-PM2-BTD	0.10			0.13			< 0.03
	22-PM2-EX	4.00			0.15			0.08		22-PM2-BTD	2.50			0.13			0.08
	23-PM2-EX	4.00			0.24			0.18		23-PM2-BTD	0.50			0.33			0.20

Table D-43. Phase IV Jar Test Phosphorus Data Continued

Influent and QC Samples								
Sample	Log Number	Notes	Q	R	Phos-T (mg-P/L)	Q	R	Phos-D (mg-P/L)
Inf, Day 1								
	17A-INF-1	Influent			0.12		<	0.03
	18-INF-1	Influent			0.27			0.03
	19-INF-1	Influent			0.36		<	0.03
	20-I1A	before spike			1.35		<	0.03
	20-I1B	after spike			1.51			0.08
	21-I1	Influent			0.66		<	0.03
	22-I1	Influent			0.69			0.09
	23-I1	Influent			0.83			0.19
Inf, Day 2								
	17A-INF-2	Influent			0.11		<	0.03
	18-INF-2	Influent			0.27		<	0.03
	19-INF-2	Influent			0.31		<	0.03
	20-I3	Influent			1.39			0.05
	21-I2	Influent			0.56		<	0.03
	22-I2	Influent			0.62			0.08
	22-I3	Influent			0.62			0.07
	23-I2	Influent			0.68			0.19
Eq Blk, Day 1								
	17A-EB-1	Eq Blk		<	0.03		<	0.03
	18-EB-1	Eq Blk		<	0.03		<	0.03
	19-EB-1	Eq Blk		<	0.03		<	0.03
	20-EB1	Eq Blk			0.13		<	0.03
	21-EB1	Eq Blk		<	0.03		<	0.03
	22-EB1	Eq Blk		<	0.03		<	0.03
	23-EB1	Eq Blk		<	0.03		<	0.03
Btl Blk, Day 1								
	17A-BB-1	Bottle Blk		<	0.03		<	0.03
	18-BB-1	Bottle Blk		<	0.03		<	0.03
	19-BB-1	Bottle Blk			0.03		<	0.03
	20-BB1	Bottle Blk		<	0.03		<	0.03
	21-BB1	Bottle Blk		<	0.03		<	0.03
	22-BB1	Bottle Blk		<	0.03		<	0.03
	23-BB1	Bottle Blk		<	0.03		<	0.03

Influent an QC Duplicate Samples								
Sample	Log Number	Notes	Q	R	Phos-T (mg-P/L)	Q	R	Phos-D (mg-P/L)
Inf, Day 1 Dup								
	17A-ID-1	Influent dup			0.12		<	0.03
	18-ID-1	Influent dup			0.34		<	0.03
	19-ID-1	Influent dup			0.34		<	0.03
	-	-			-			-
	20-I2B	(after spike)			1.37			0.11
	21-ID1	Influent			0.62		<	0.03
	22-ID1	Influent			No sample			
	23-ID1	Influent			1.10			0.19
Inf, Day 2 Dup								
	17A-ID-2	Influent dup			0.12		<	0.03
	18-ID-2	Influent dup			0.34		<	0.03
	19-ID-2	Influent dup			0.39		<	0.03
	20-I3D	Influent dup			1.45			0.05
	21-ID2	Influent dup			0.57		<	0.03
	22-ID2	Influent dup			0.65			0.08
	22-I3D	Influent dup			0.63			0.07
	23-ID2	Influent dup			0.68			0.19
Eq Blk, Day 2								
	17A-EB-2	Eq Blk		<	0.03		<	0.03
	18-EB-3	Eq Blk		<	0.03		<	0.03
	18-EB-2	Eq Blk		<	0.03		<	0.03
	19-EB-2	Eq Blk		<	0.03		<	0.03
	20-EB2	Eq Blk		<	0.03		<	0.03
	21-EB2	Eq Blk		<	0.03		<	0.03
	22-EB2	Eq Blk		<	0.03		<	0.03
Btl Blk, Day 2								
	17A-BB-2	Bottle Blk		<	0.03		<	0.03
	18-BB-3	Bottle Blk		<	0.03		<	0.03
	18-BB-2	Bottle Blk		<	0.03		<	0.03
	19-BB-2	Bottle Blk		<	0.03		<	0.03
	20-BB2	Bottle Blk		<	0.03		<	0.03
	21-BB2	Bottle Blk		<	0.03		<	0.03
	22-BB2	Bottle Blk		<	0.03		<	0.03

Appendix E

Jar Test Experiments - Graphs

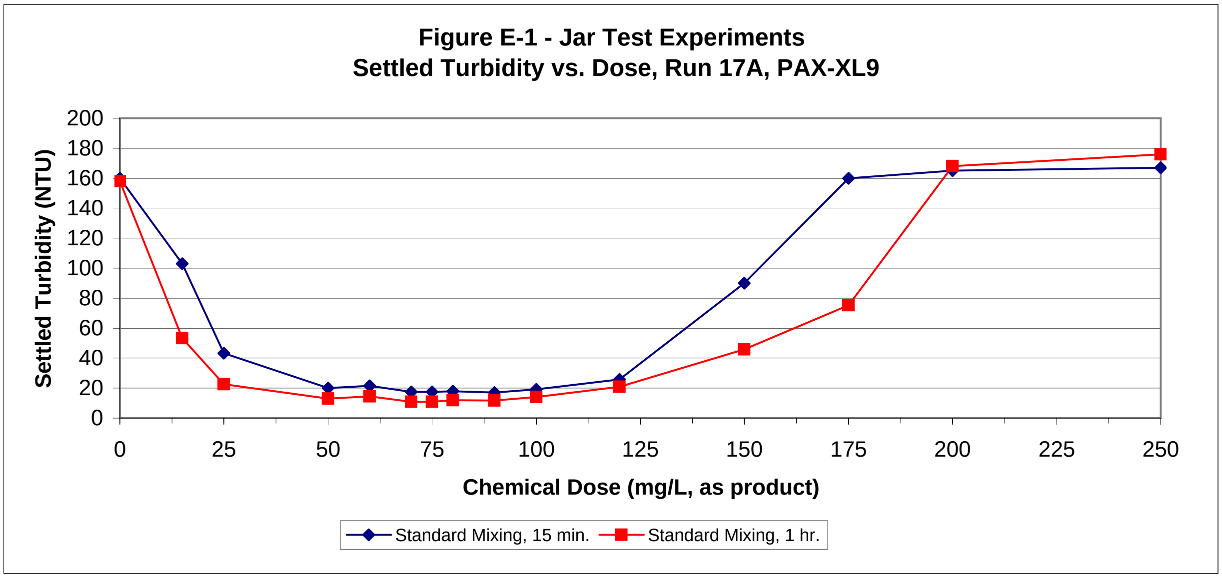


Figure E-1 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 17A, PAX-XL9
Settled Turbidity (NTU)
0
20
40
60
80
100
120
140
160
180
200
0
25
50
75
100
125
150
175
200
225
250
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

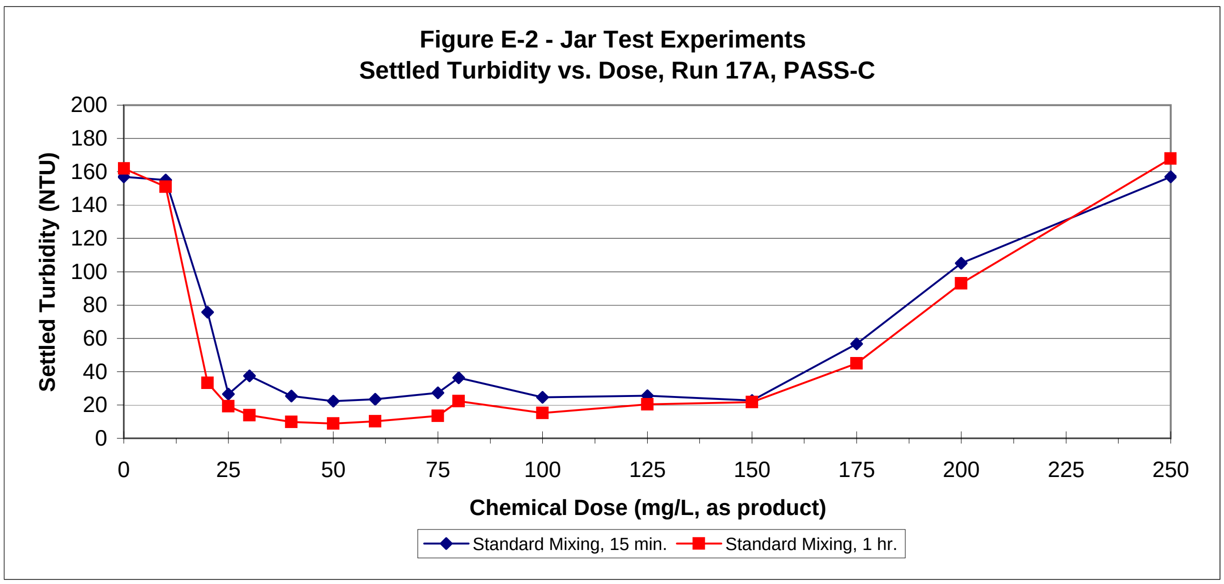


Figure E-2 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 17A, PASS-C
Settled Turbidity (NTU)
0
20
40
60
80
100
120
140
160
180
200
0
25
50
75
100
125
150
175
200
225
250
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

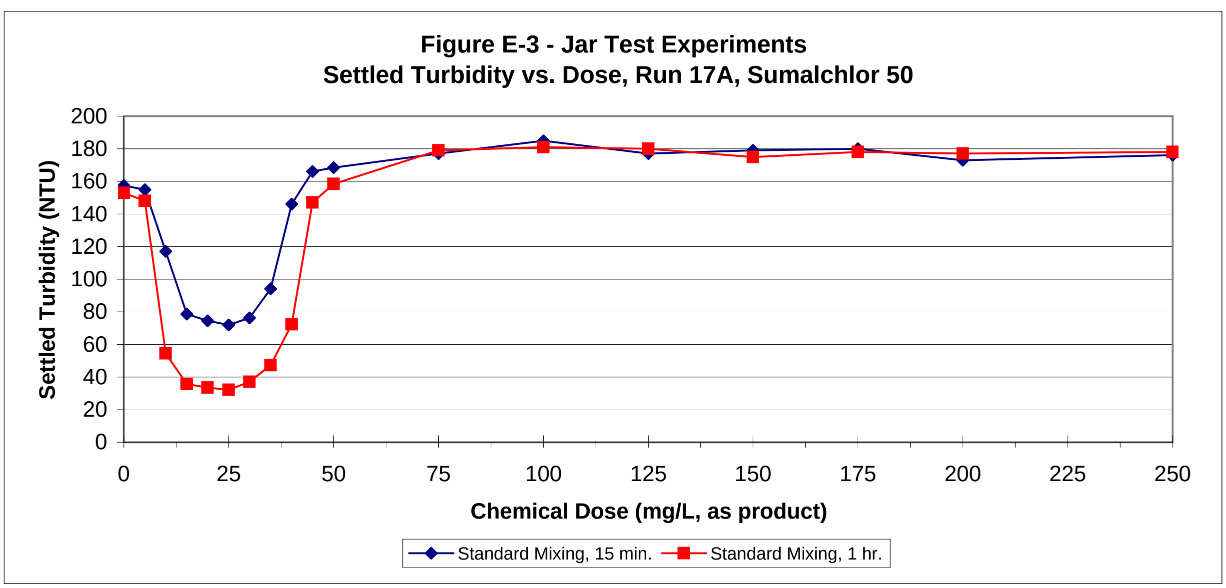


Figure E-3 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 17A, Sumalchlor 50
Settled Turbidity (NTU)
0
20
40
60
80
100
120
140
160
180
200
0
25
50
75
100
125
150
175
200
225
250
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

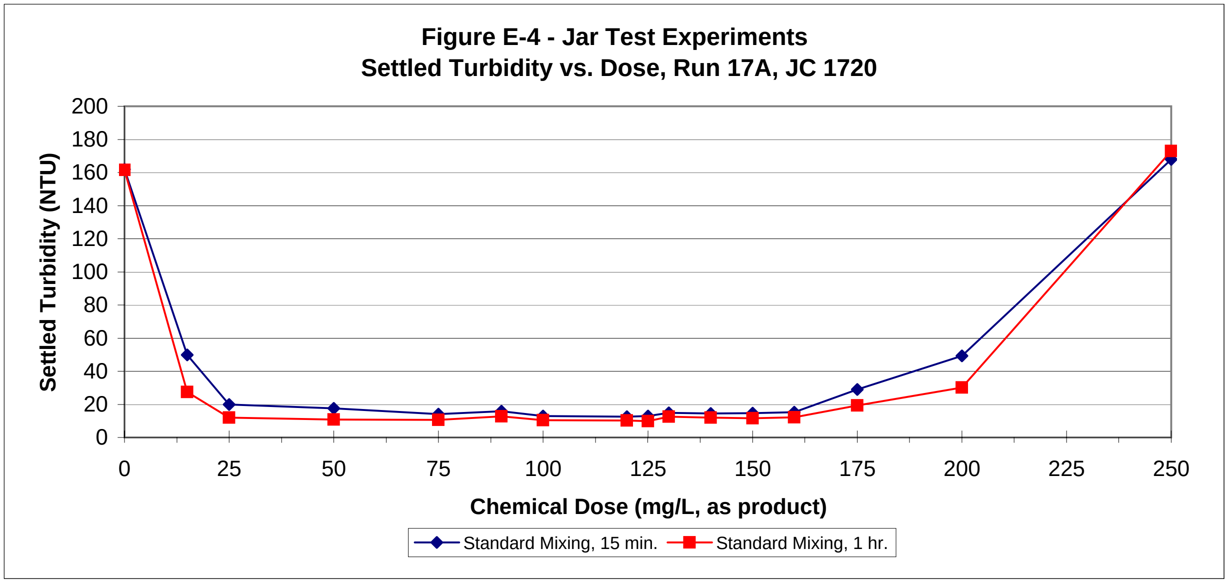


Figure E-4 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 17A, JC 1720
Settled Turbidity (NTU)
0
20
40
60
80
100
120
140
160
180
200
0
25
50
75
100
125
150
175
200
225
250
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

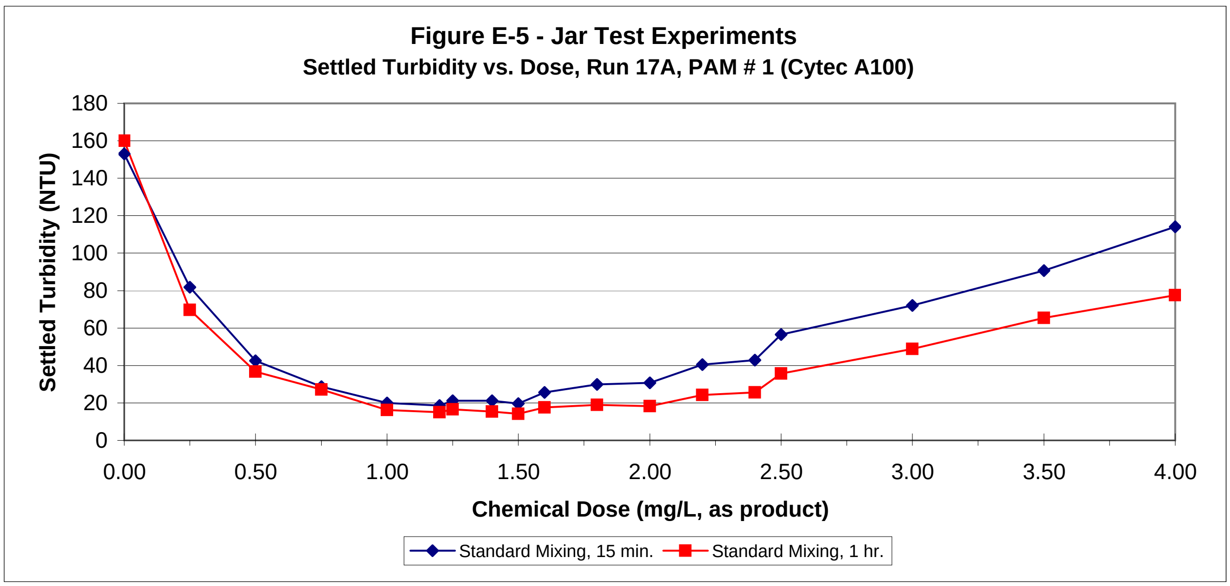


Figure E-5 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 17A, PAM # 1 (Cytec A100)
Settled Turbidity (NTU)
0
20
40
60
80
100
120
140
160
180
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

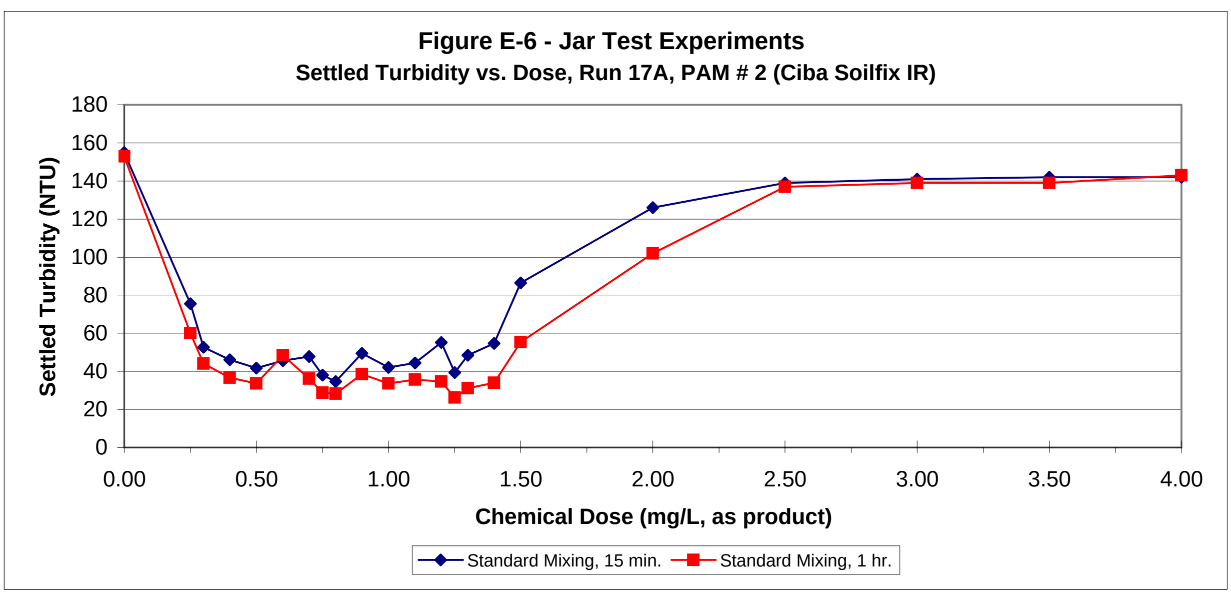


Figure E-6 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 17A, PAM # 2 (Ciba Soilfix IR)
Settled Turbidity (NTU)
0
20
40
60
80
100
120
140
160
180
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

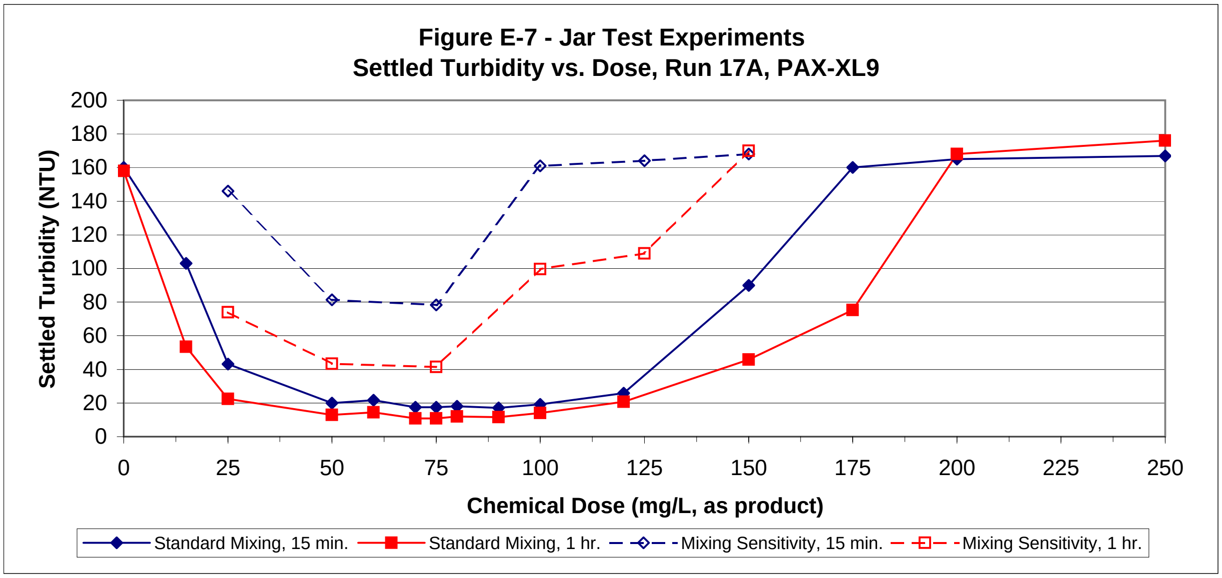


Figure E-7 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 17A, PAX-XL9
Settled Turbidity (NTU)
0
20
40
60
80
100
120
140
160
180
200
0
25
50
75
100
125
150
175
200
225
250
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

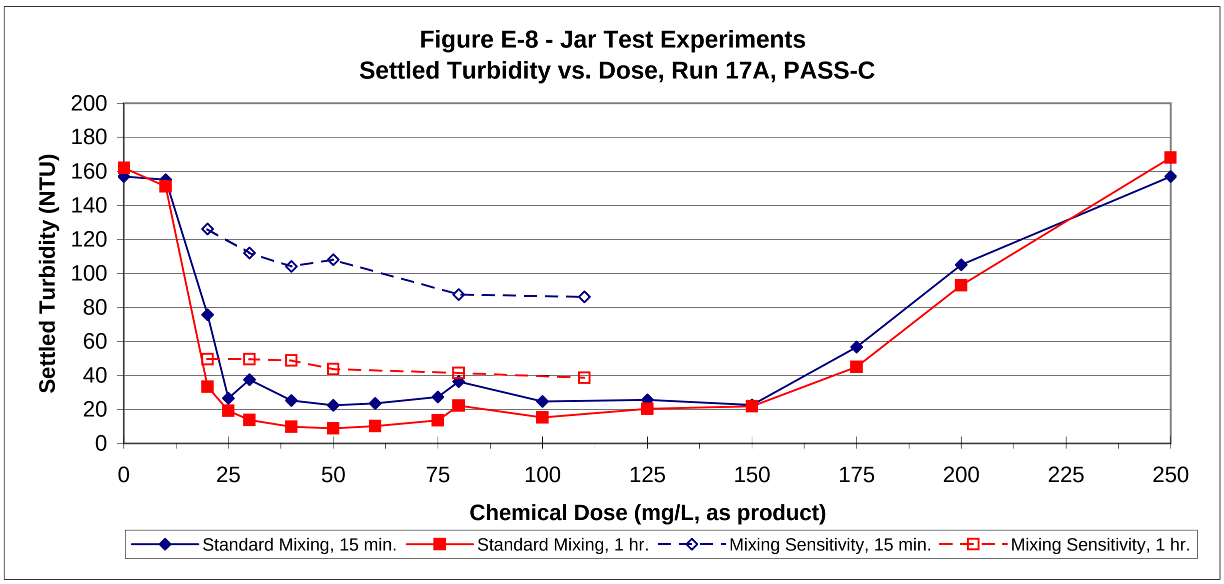


Figure E-8 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 17A, PASS-C
Settled Turbidity (NTU)
0
20
40
60
80
100
120
140
160
180
200
0
25
50
75
100
125
150
175
200
225
250
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

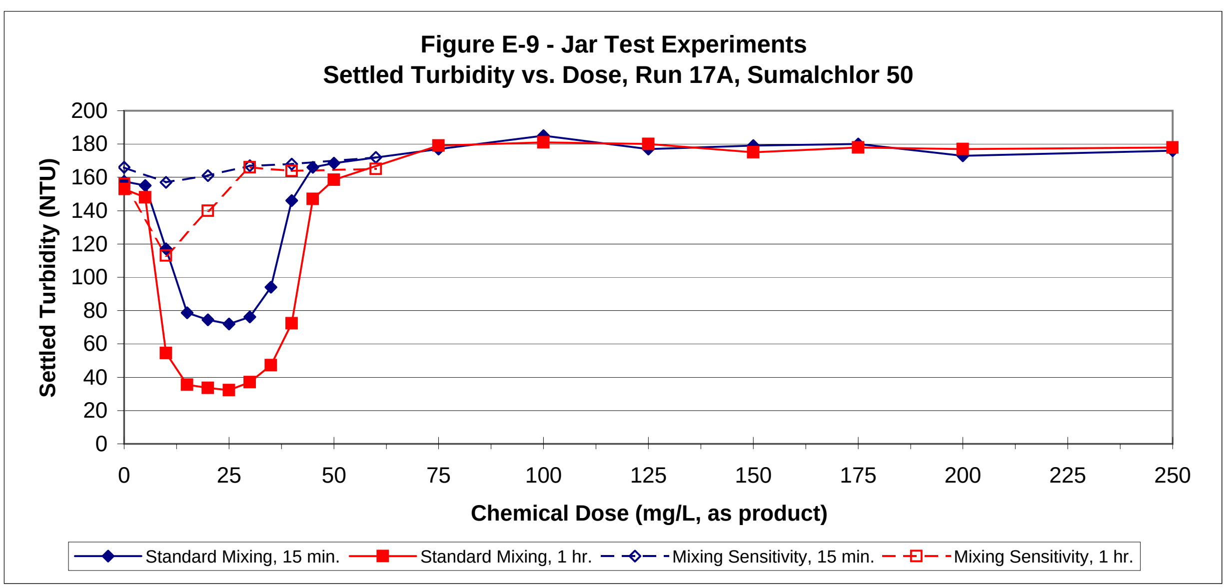


Figure E-9 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 17A, Sumalchlor 50
Settled Turbidity (NTU)
0
20
40
60
80
100
120
140
160
180
200
0
25
50
75
100
125
150
175
200
225
250
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

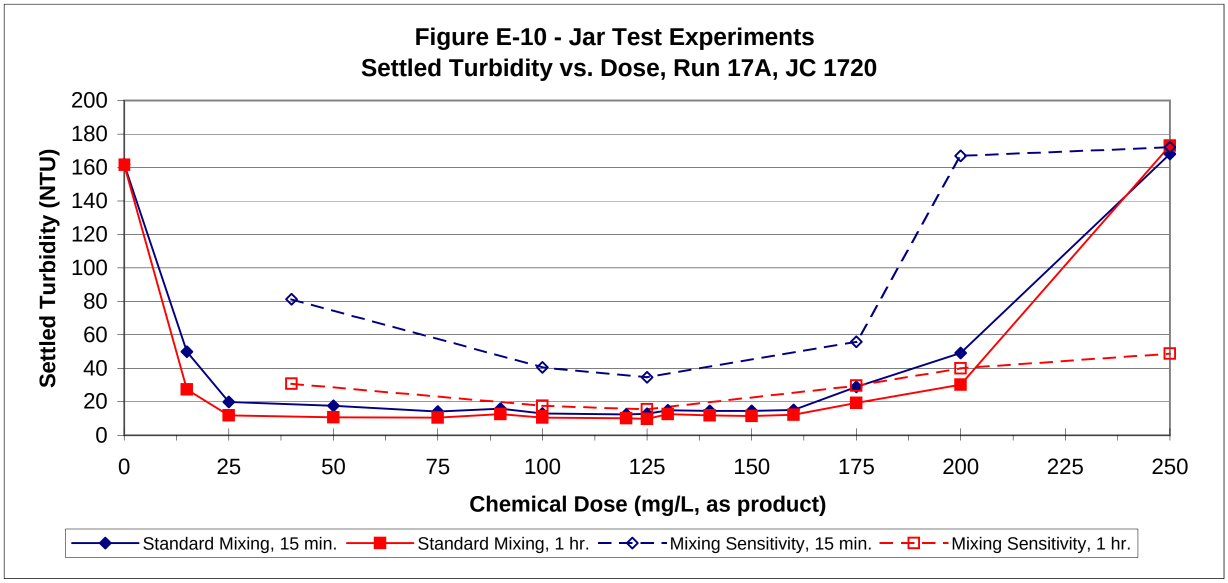


Figure E-10 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 17A, JC 1720
Settled Turbidity (NTU)
0
20
40
60
80
100
120
140
160
180
200
0
25
50
75
100
125
150
175
200
225
250
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

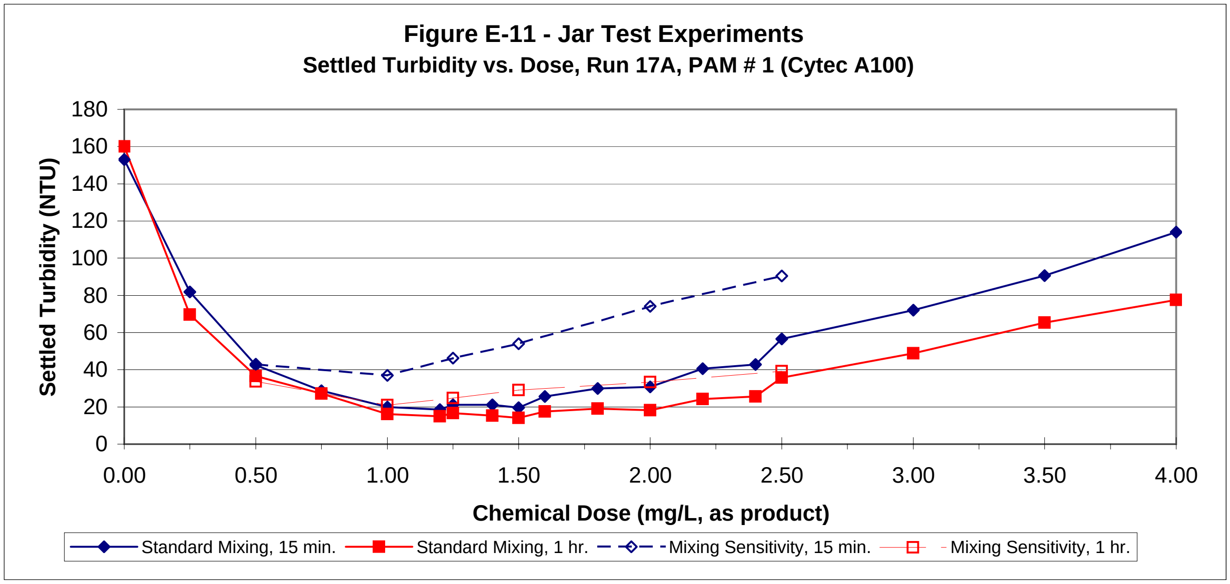


Figure E-11 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 17A, PAM # 1 (Cytec A100)
Settled Turbidity (NTU)
0
20
40
60
80
100
120
140
160
180
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

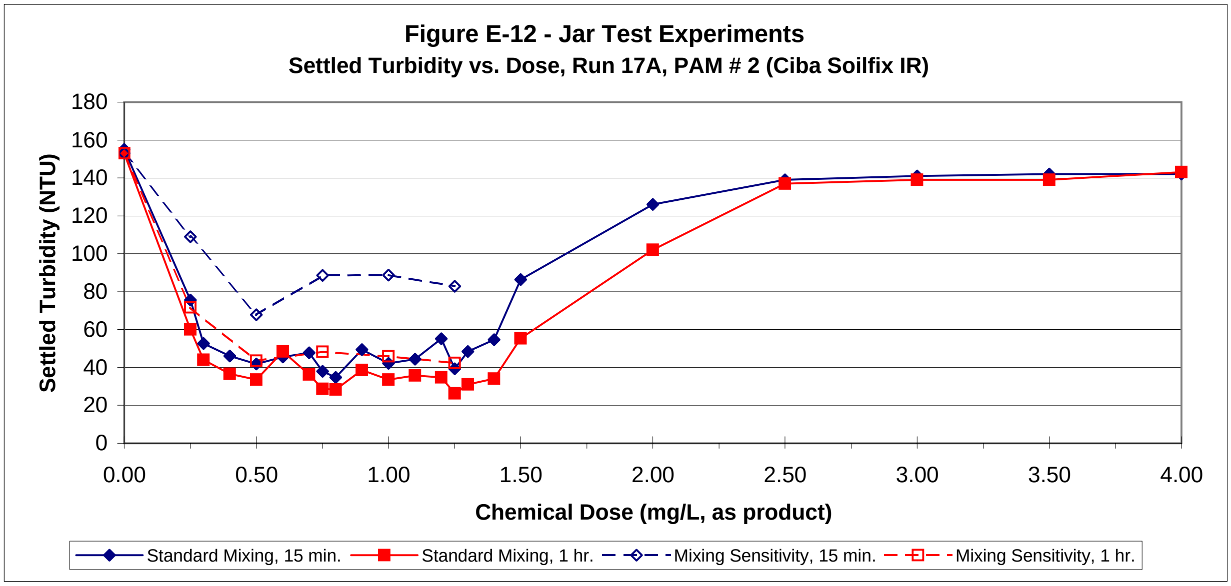


Figure E-12 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 17A, PAM # 2 (Ciba Soilfix IR)
Settled Turbidity (NTU)
0
20
40
60
80
100
120
140
160
180
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

Figure E-13 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 17A, PAX-XL9

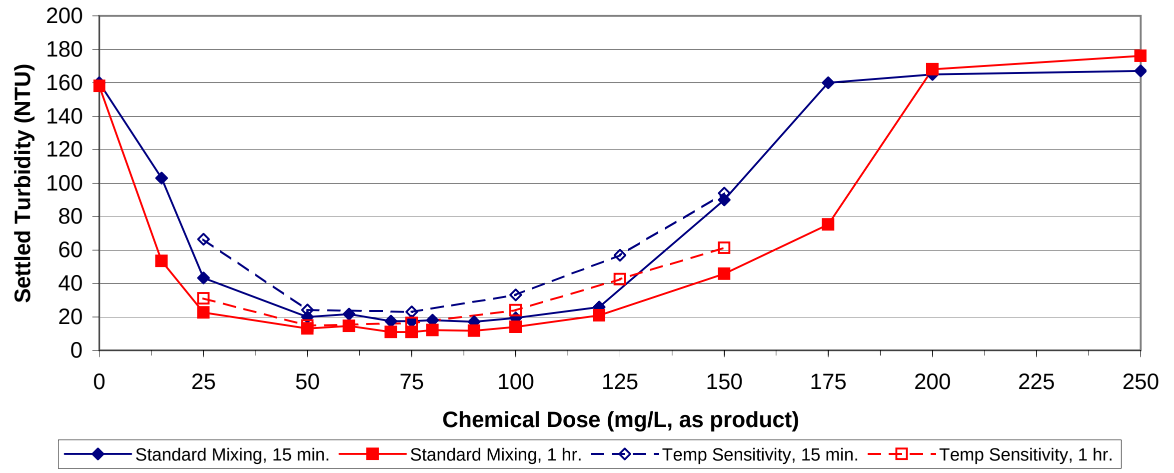


Figure E-14 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 17A, PASS-C

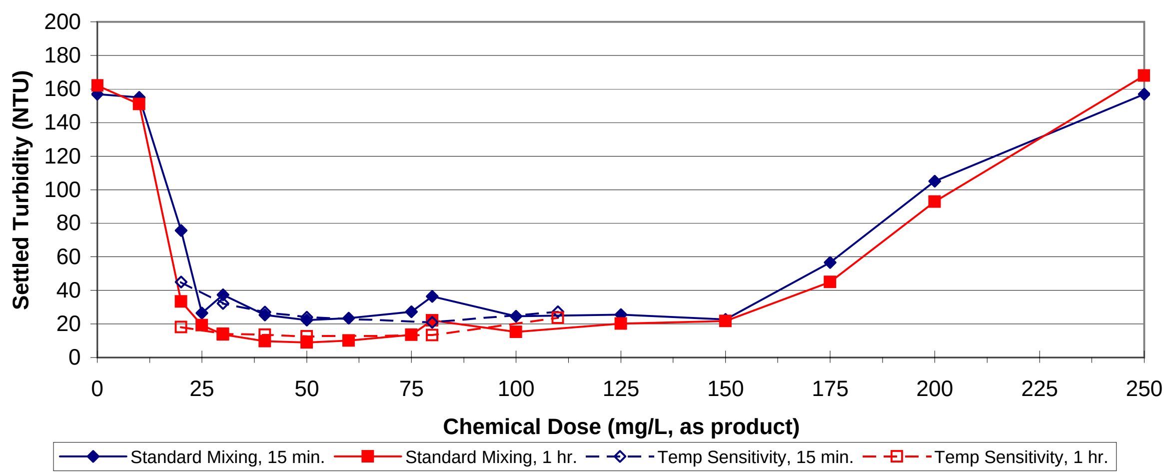
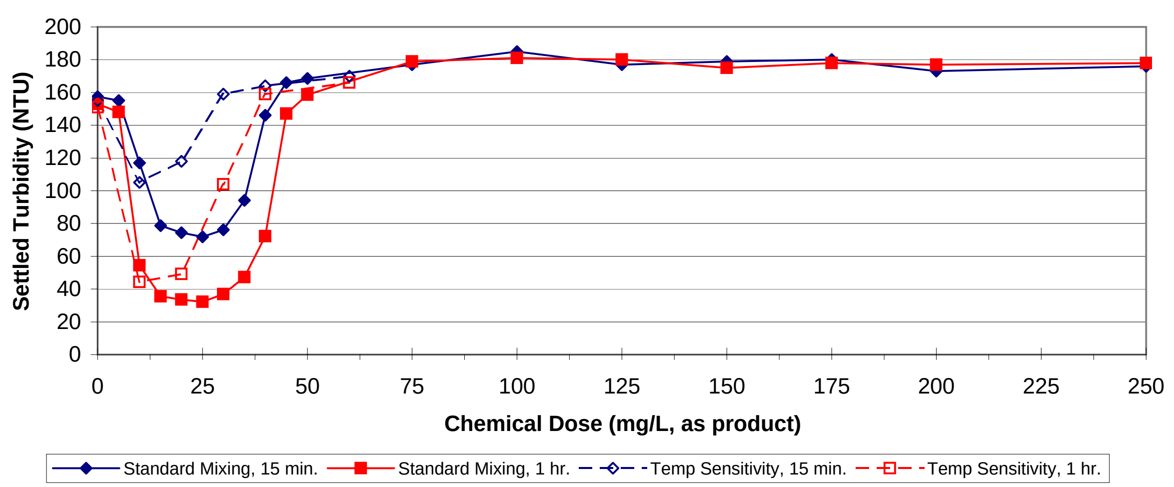


Figure E-15 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 17A, Sumalchlor 50



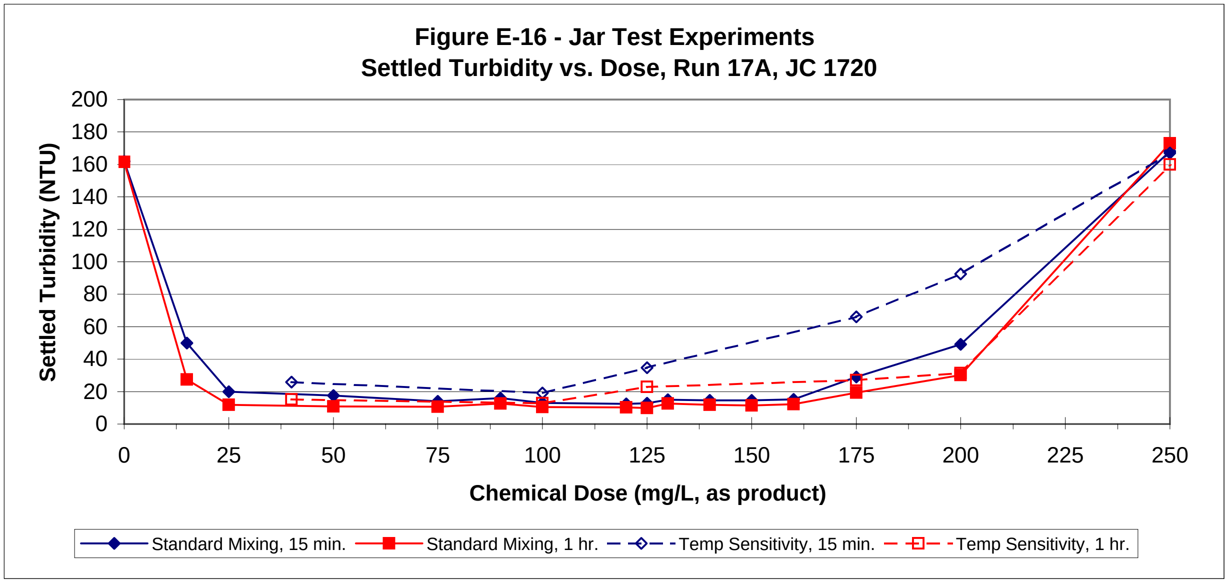


Figure E-16 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 17A, JC 1720
Settled Turbidity (NTU)
0
20
40
60
80
100
120
140
160
180
200
0
25
50
75
100
125
150
175
200
225
250
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Temp Sensitivity, 15 min.
Temp Sensitivity, 1 hr.

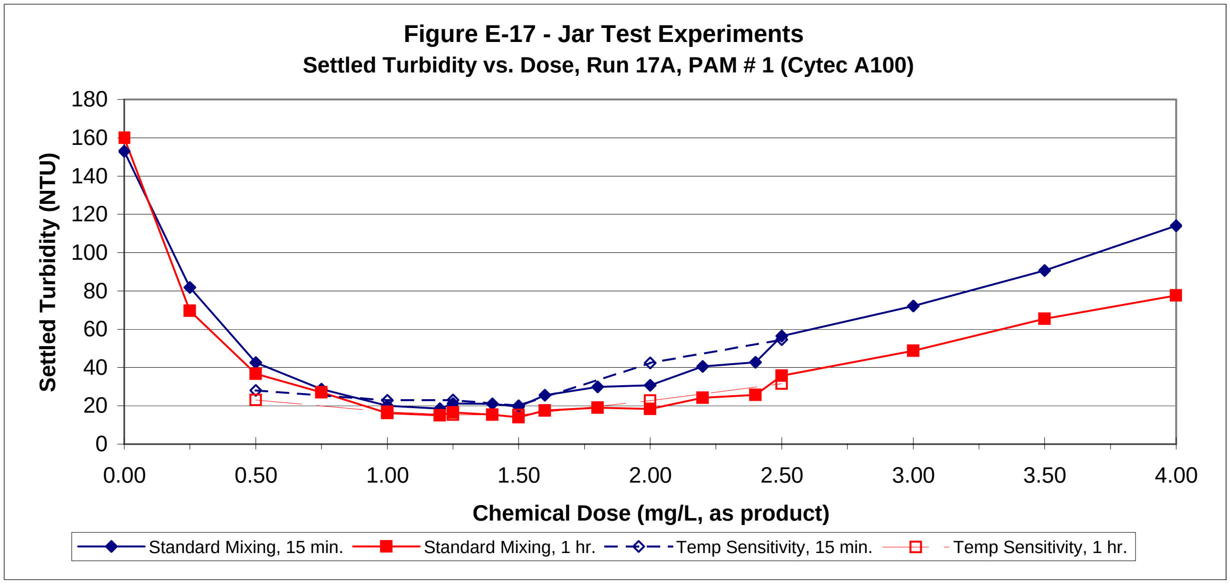


Figure E-17 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 17A, PAM # 1 (Cytec A100)
Settled Turbidity (NTU)
0
20
40
60
80
100
120
140
160
180
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Temp Sensitivity, 15 min.
Temp Sensitivity, 1 hr.

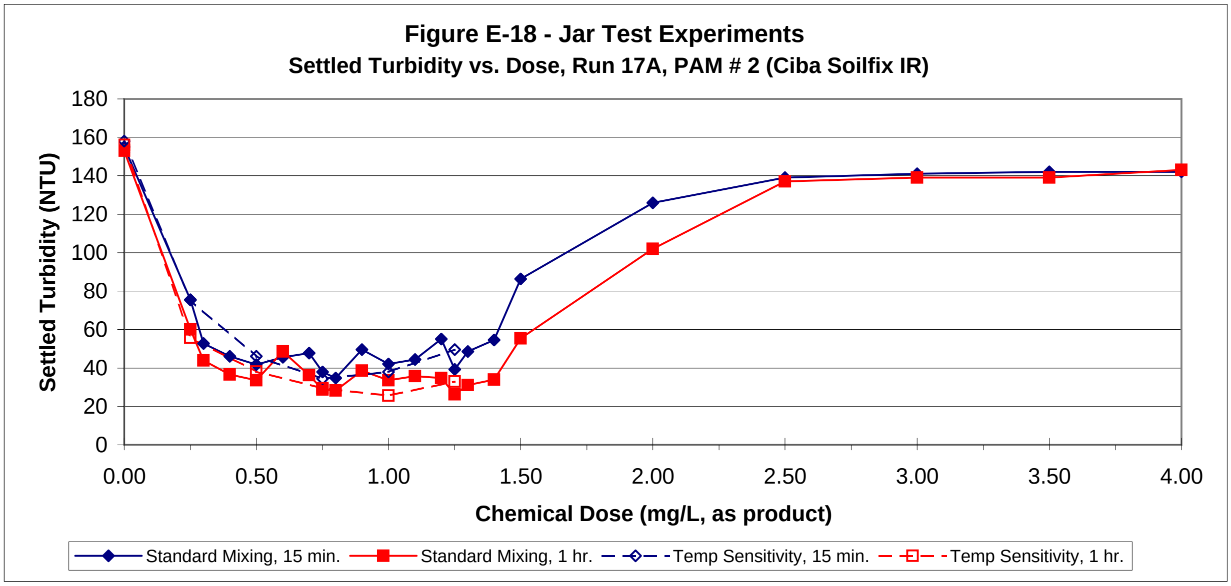


Figure E-18 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 17A, PAM # 2 (Ciba Soilfix IR)
Settled Turbidity (NTU)
0
20
40
60
80
100
120
140
160
180
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Temp Sensitivity, 15 min.
Temp Sensitivity, 1 hr.

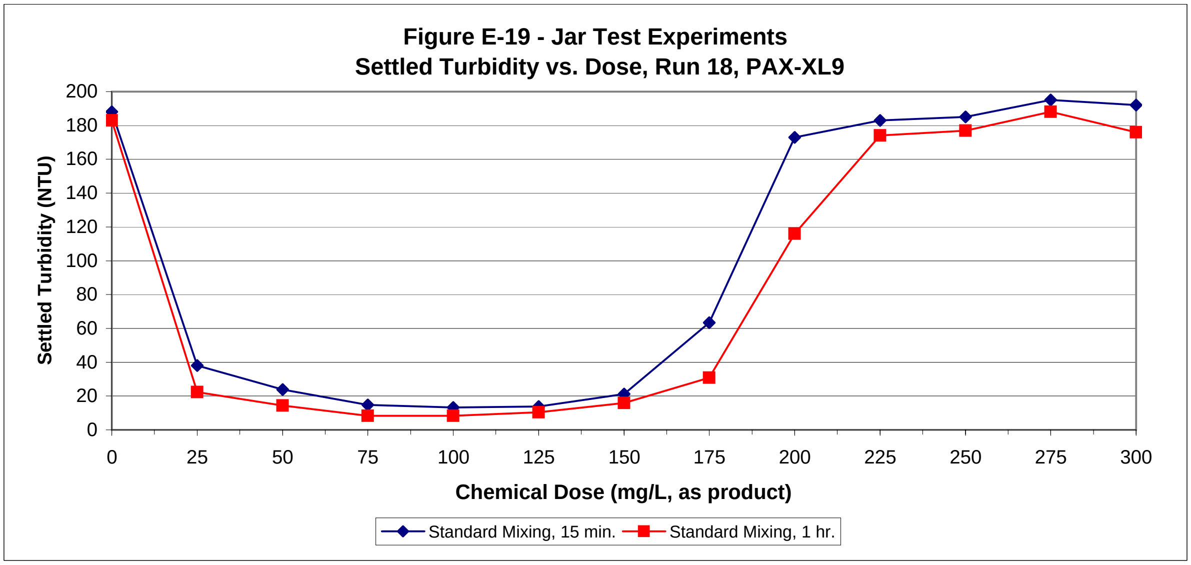


Figure E-19 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 18, PAX-XL9
Settled Turbidity (NTU)
0
20
40
60
80
100
120
140
160
180
200
0
25
50
75
100
125
150
175
200
225
250
275
300
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

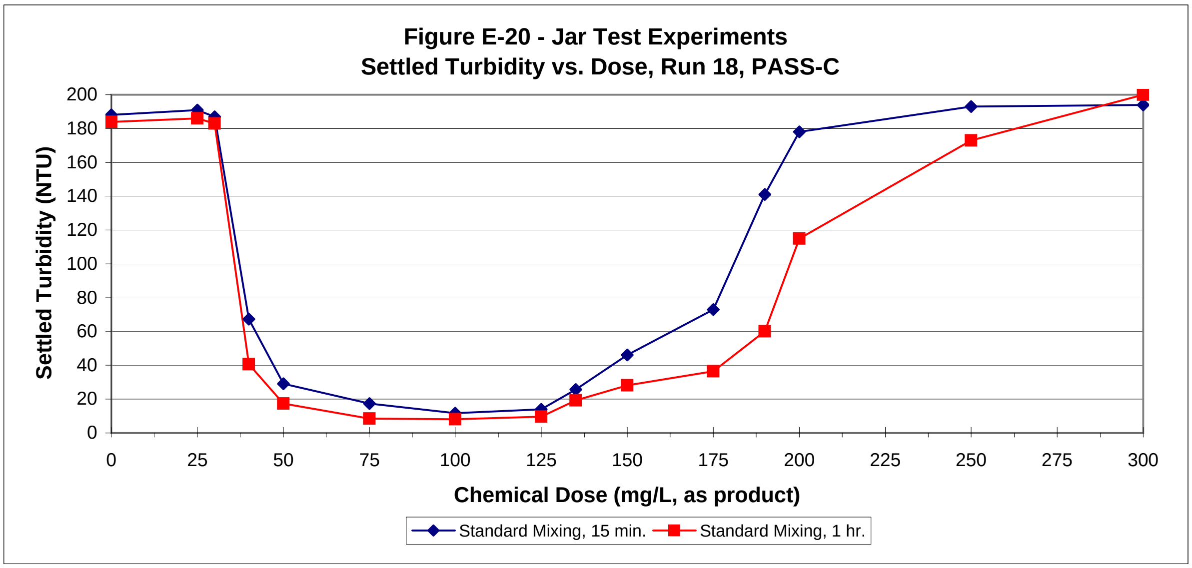


Figure E-20 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 18, PASS-C
Settled Turbidity (NTU)
0
20
40
60
80
100
120
140
160
180
200
0
25
50
75
100
125
150
175
200
225
250
275
300
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

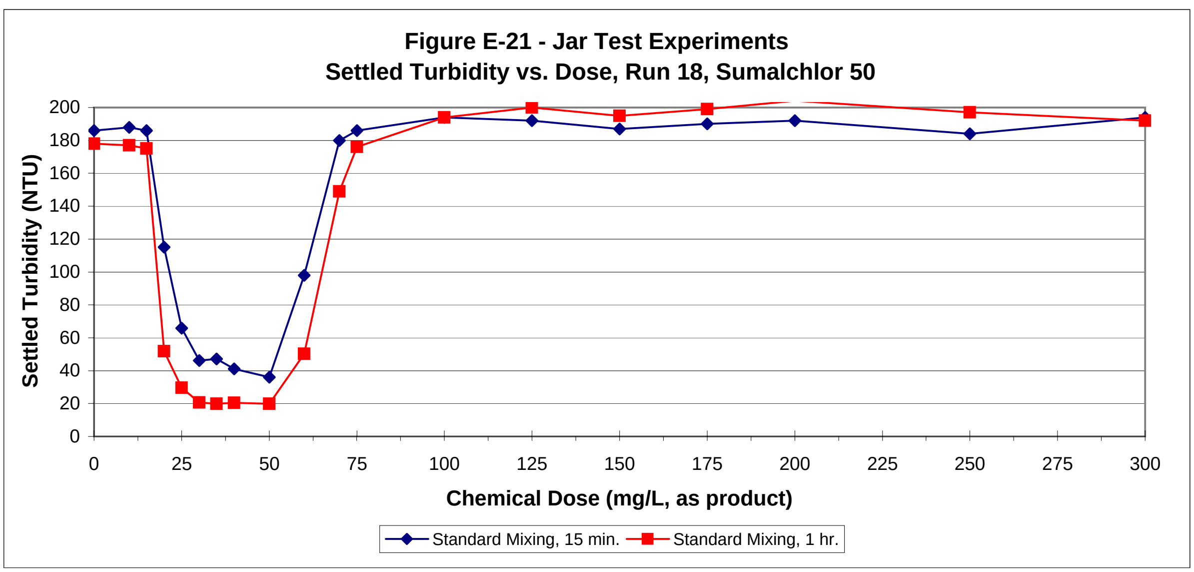


Figure E-21 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 18, Sumalchlor 50
Settled Turbidity (NTU)
0
20
40
60
80
100
120
140
160
180
200
0
25
50
75
100
125
150
175
200
225
250
275
300
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

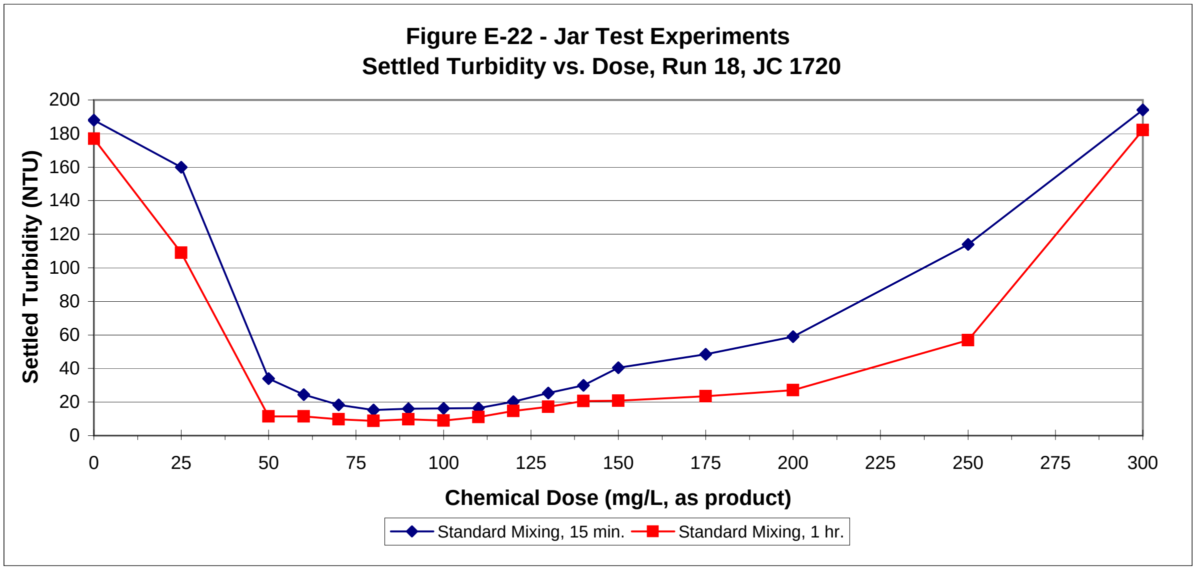


Figure E-22 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 18, JC 1720
Settled Turbidity (NTU)
200
180
160
140
120
100
80
60
40
20
0
0
25
50
75
100
125
150
175
200
225
250
275
300
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

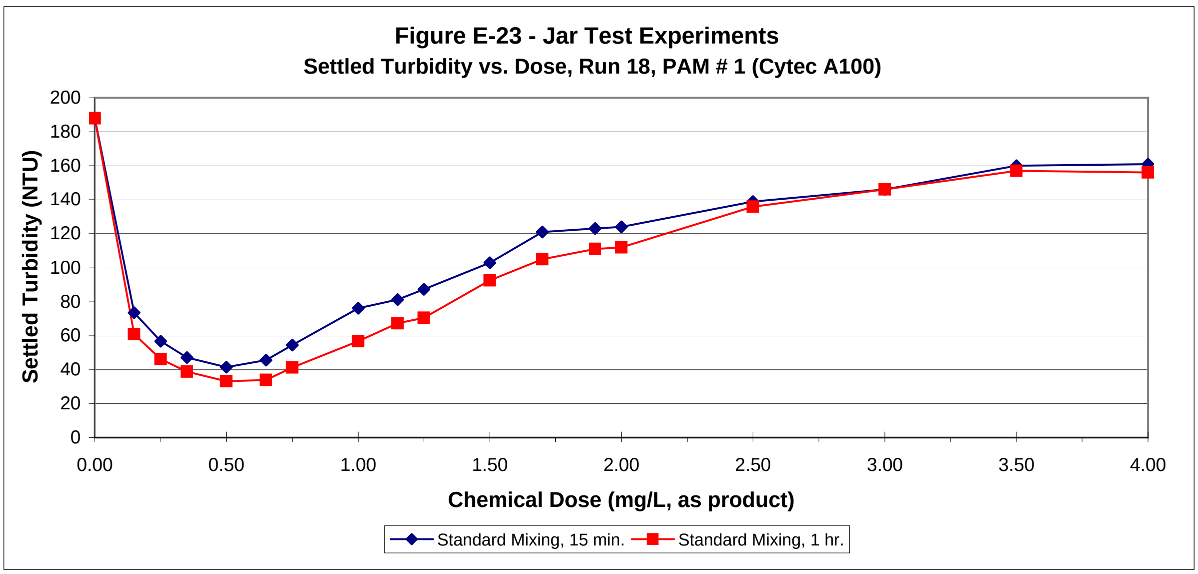


Figure E-23 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 18, PAM # 1 (Cytec A100)
Settled Turbidity (NTU)
200
180
160
140
120
100
80
60
40
20
0
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

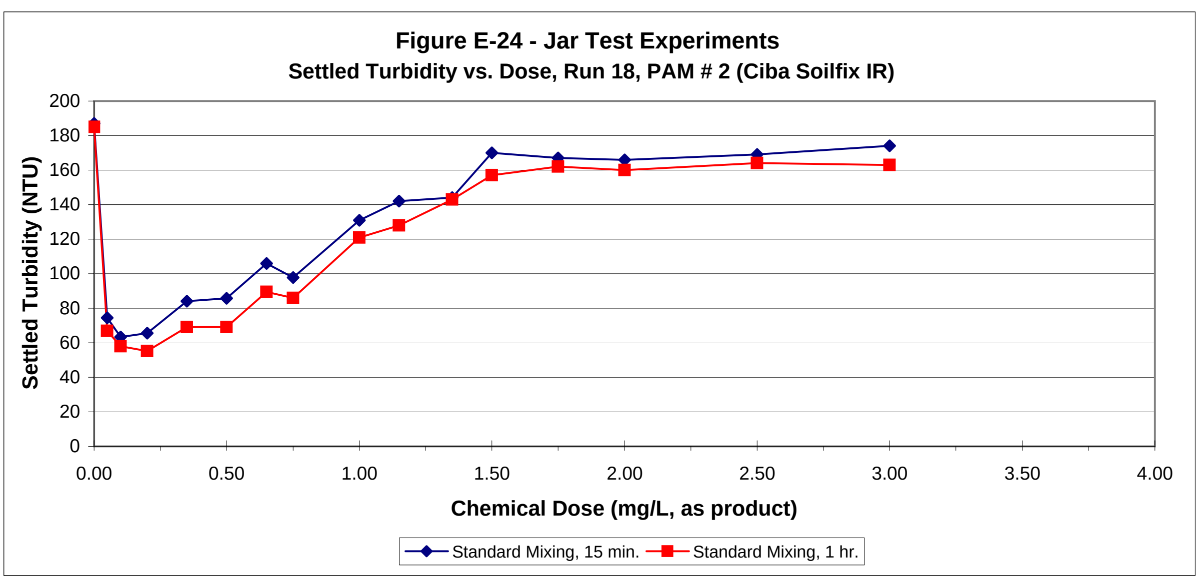


Figure E-24 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 18, PAM # 2 (Ciba Soilfix IR)
Settled Turbidity (NTU)
200
180
160
140
120
100
80
60
40
20
0
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

Figure E-25 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 18, PAX-XL9

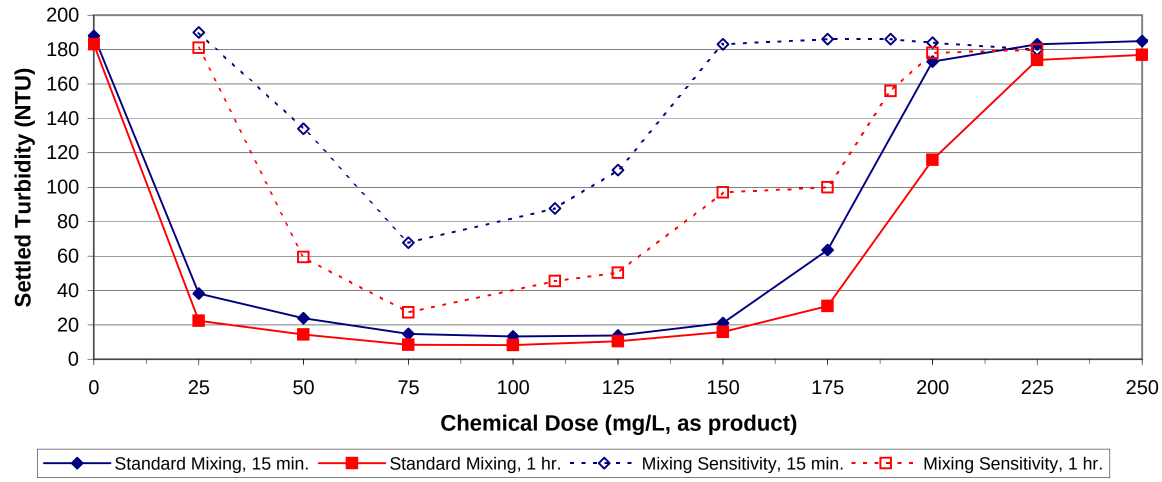


Figure E-26 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 18, PASS-C

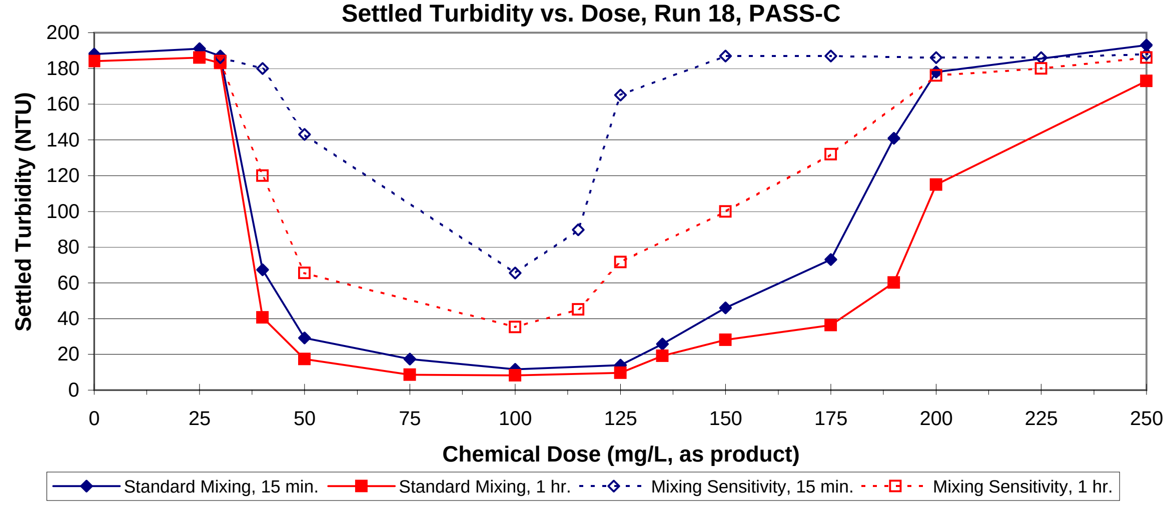
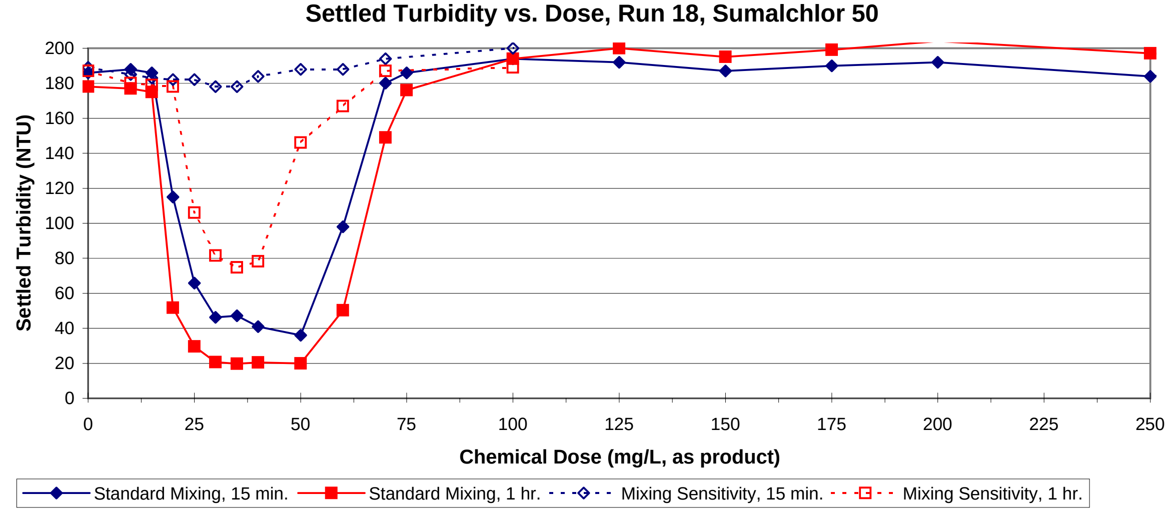


Figure E-27 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 18, Sumalchlor 50



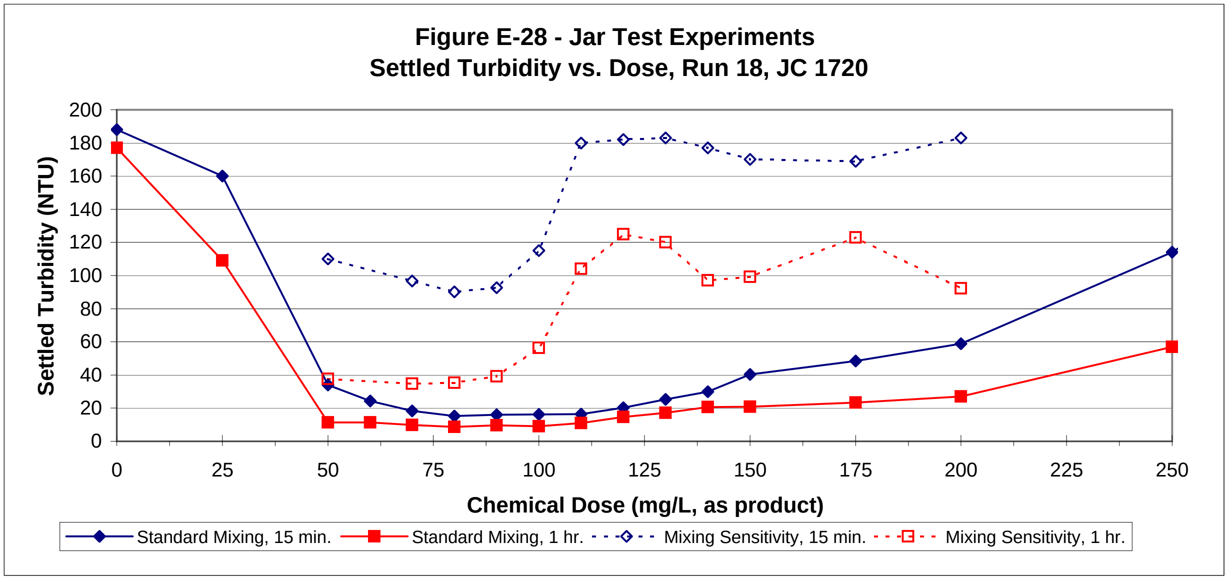


Figure E-28 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 18, JC 1720
Settled Turbidity (NTU)
0
20
40
60
80
100
120
140
160
180
200
0
25
50
75
100
125
150
175
200
225
250
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

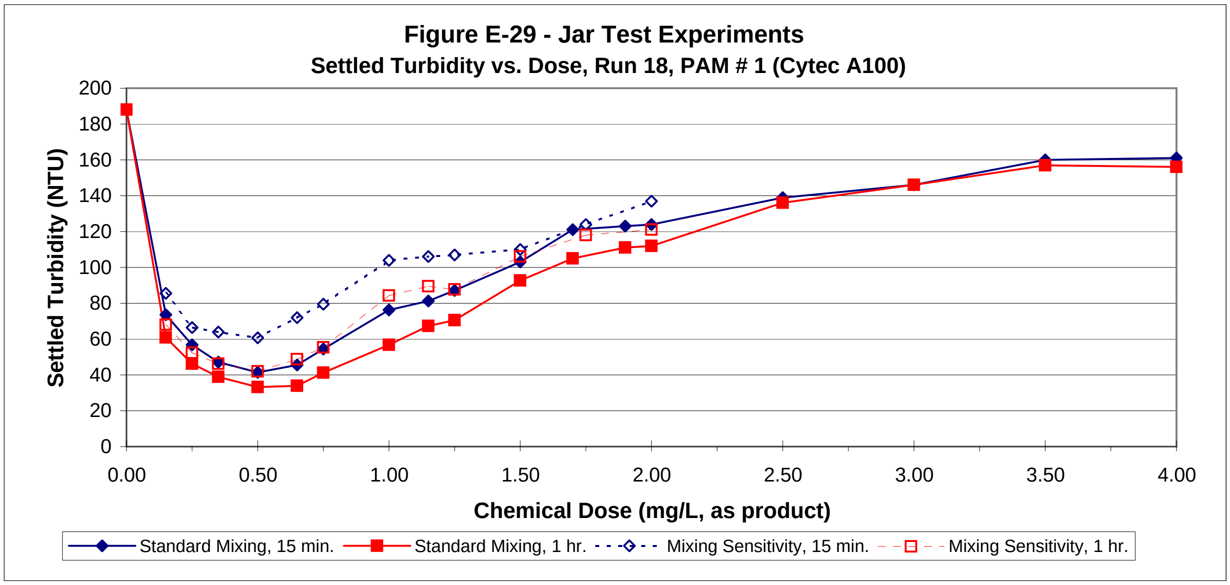


Figure E-29 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 18, PAM # 1 (Cytec A100)
Settled Turbidity (NTU)
0
20
40
60
80
100
120
140
160
180
200
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

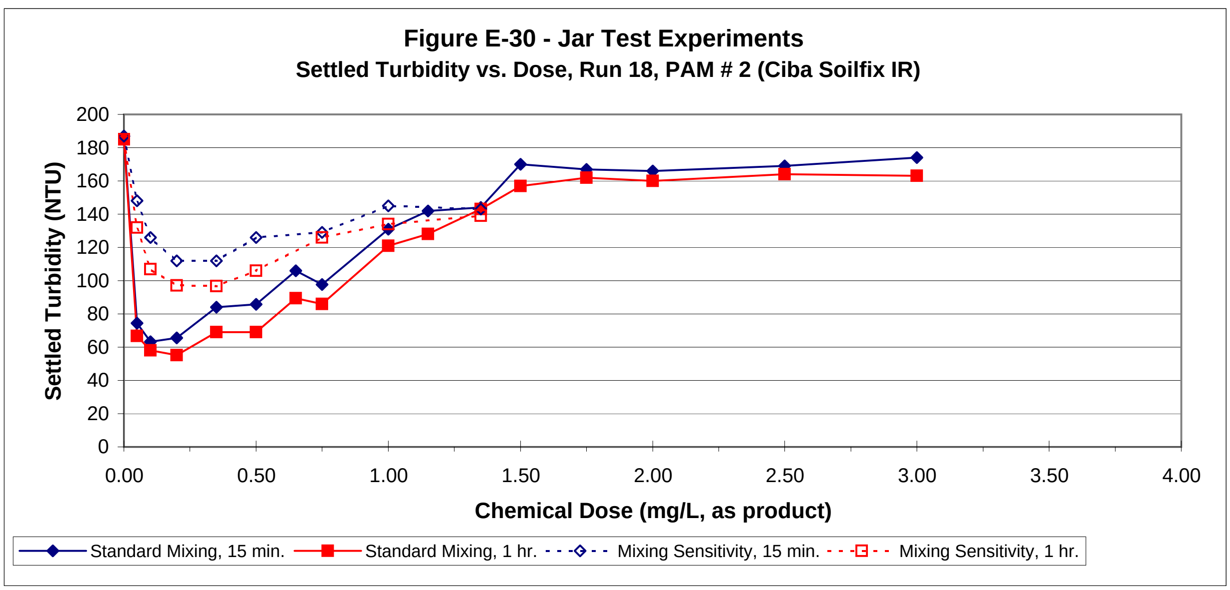


Figure E-30 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 18, PAM # 2 (Ciba Soilfix IR)
Settled Turbidity (NTU)
0
20
40
60
80
100
120
140
160
180
200
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

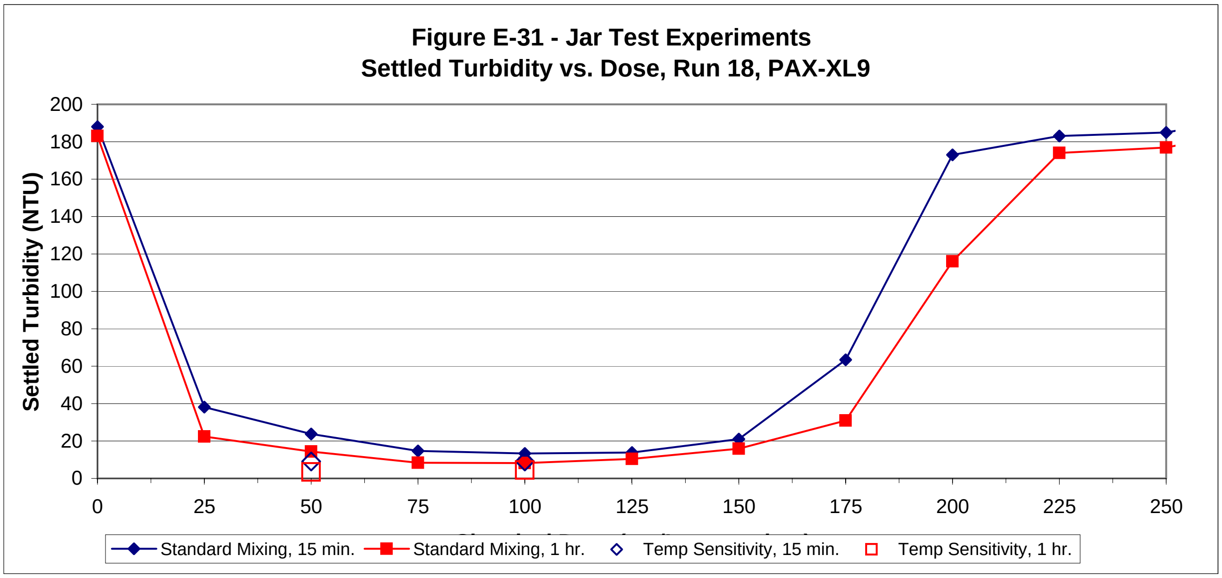


Figure E-31 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 18, PAX-XL9
Settled Turbidity (NTU)
200
180
160
140
120
100
80
60
40
20
0
0
25
50
75
100
125
150
175
200
225
250
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Temp Sensitivity, 15 min.
Temp Sensitivity, 1 hr.

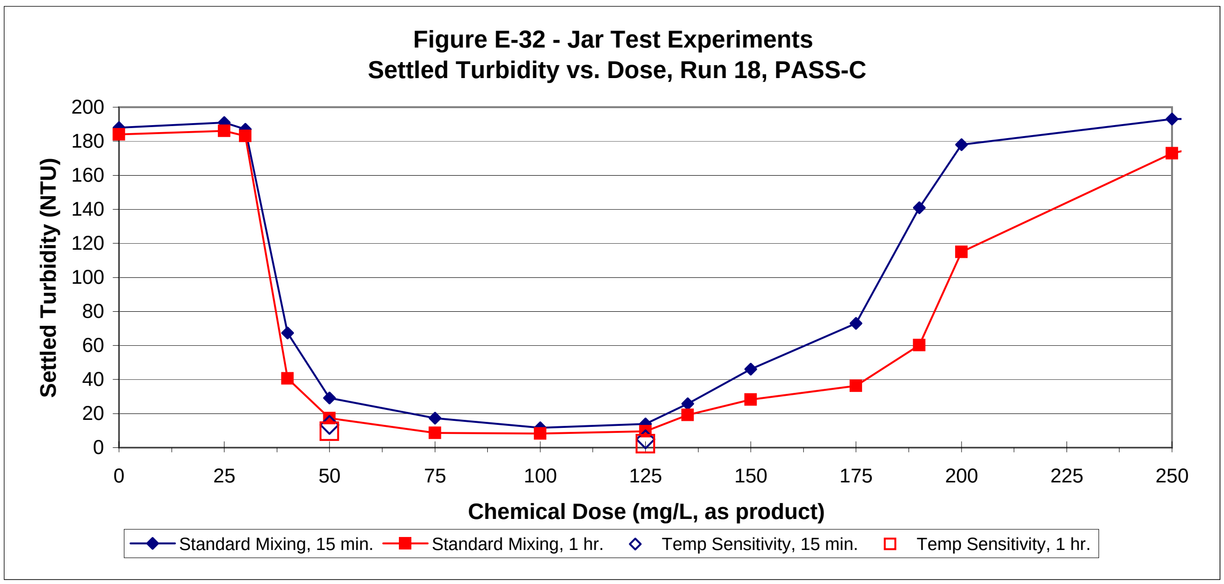


Figure E-32 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 18, PASS-C
Settled Turbidity (NTU)
200
180
160
140
120
100
80
60
40
20
0
0
25
50
75
100
125
150
175
200
225
250
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Temp Sensitivity, 15 min.
Temp Sensitivity, 1 hr.

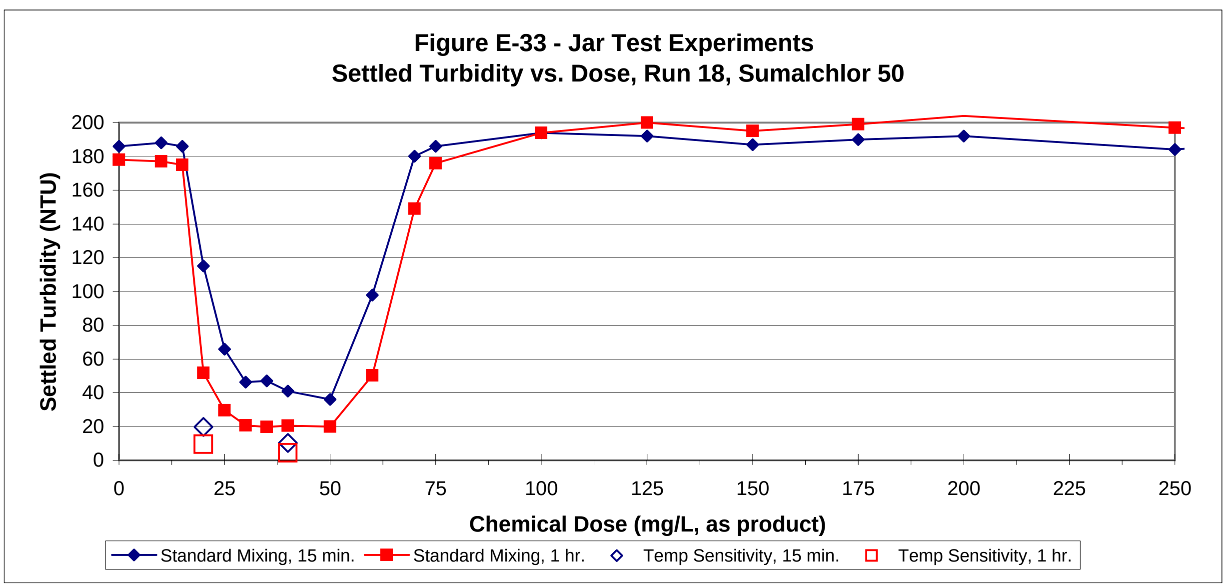


Figure E-33 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 18, Sumalchlor 50
Settled Turbidity (NTU)
200
180
160
140
120
100
80
60
40
20
0
0
25
50
75
100
125
150
175
200
225
250
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Temp Sensitivity, 15 min.
Temp Sensitivity, 1 hr.

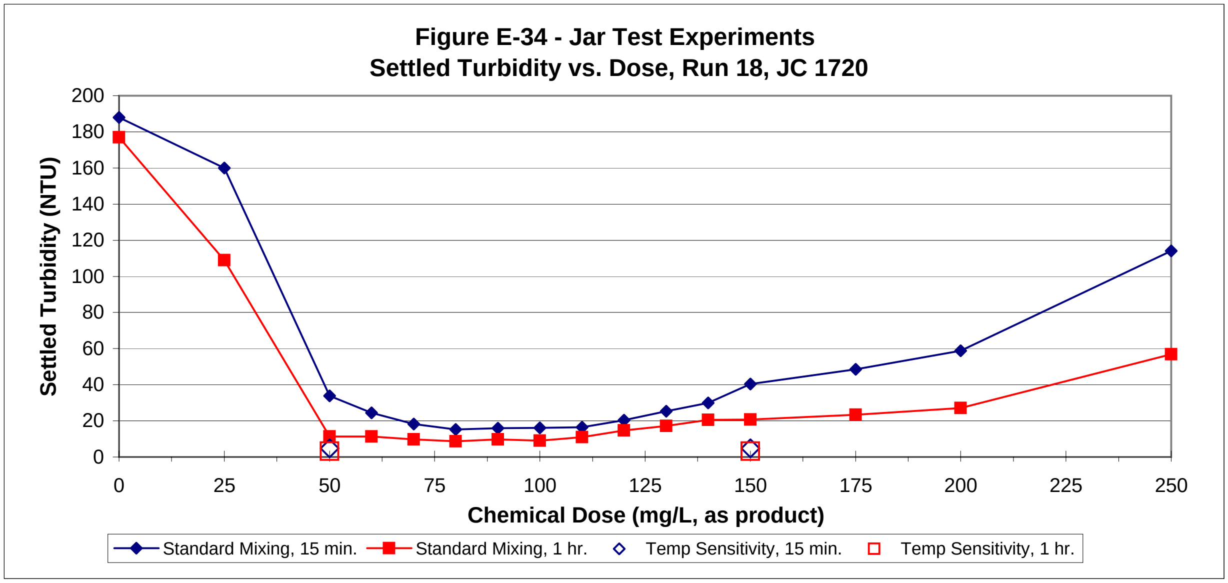


Figure E-34 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 18, JC 1720
Settled Turbidity (NTU)
0
20
40
60
80
100
120
140
160
180
200
0
25
50
75
100
125
150
175
200
225
250
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Temp Sensitivity, 15 min.
Temp Sensitivity, 1 hr.

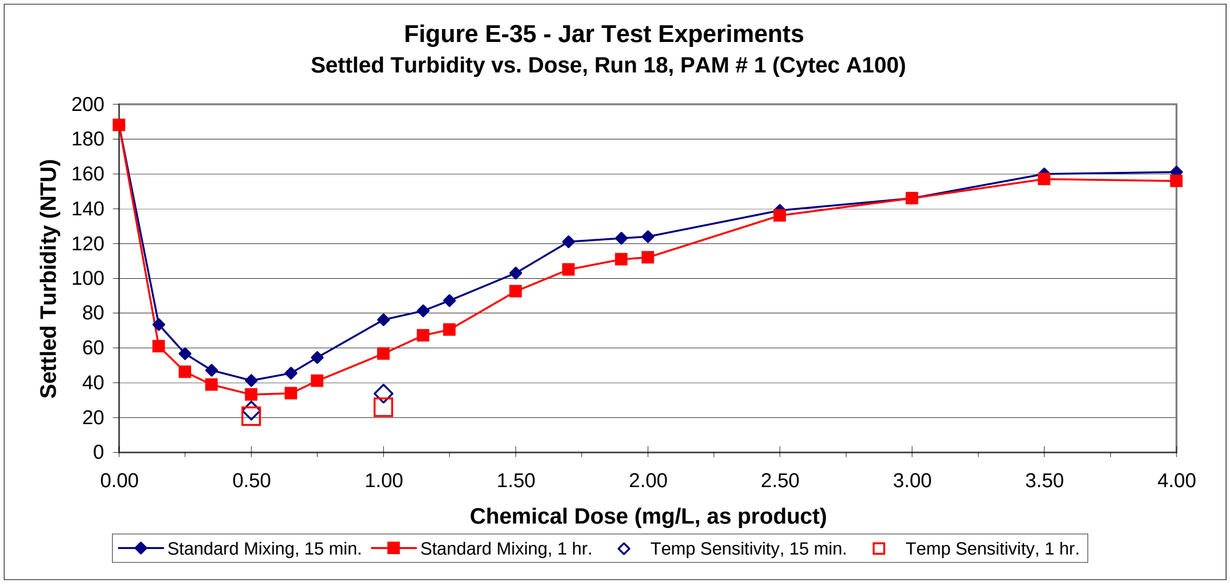


Figure E-35 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 18, PAM # 1 (Cytec A100)
Settled Turbidity (NTU)
0
20
40
60
80
100
120
140
160
180
200
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Temp Sensitivity, 15 min.
Temp Sensitivity, 1 hr.

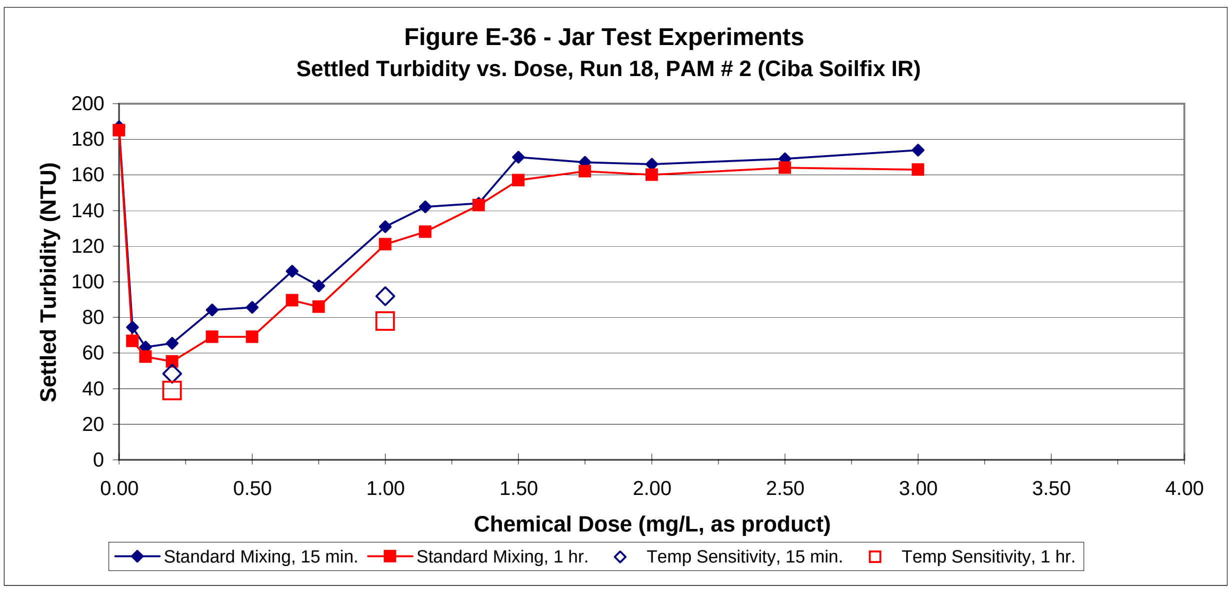


Figure E-36 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 18, PAM # 2 (Ciba Soilfix IR)
Settled Turbidity (NTU)
0
20
40
60
80
100
120
140
160
180
200
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Temp Sensitivity, 15 min.
Temp Sensitivity, 1 hr.

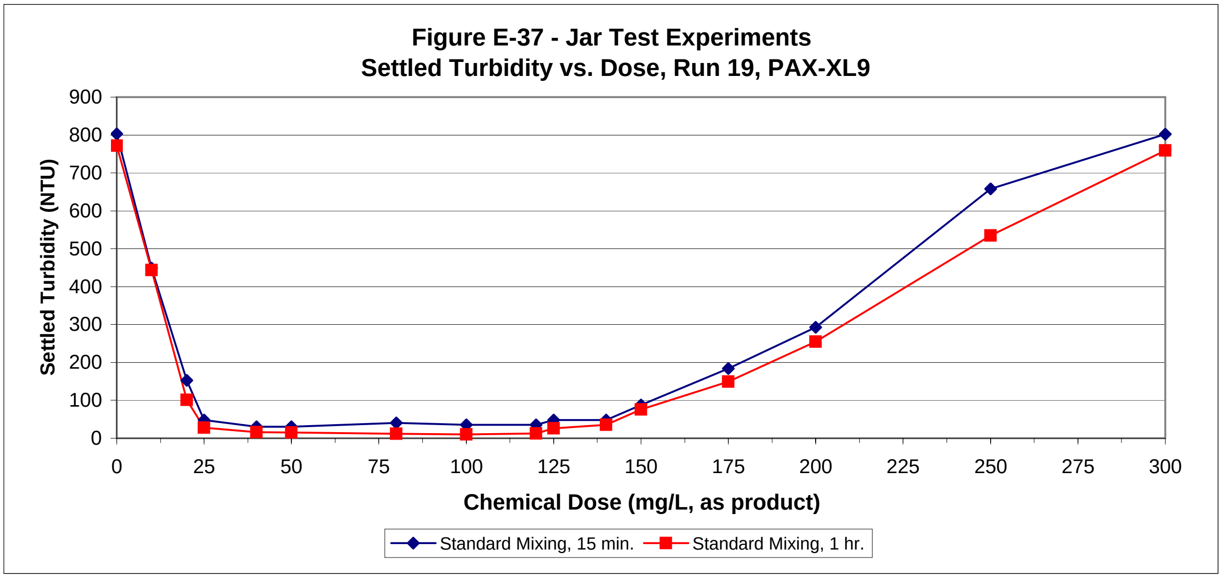


Figure E-37 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 19, PAX-XL9
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

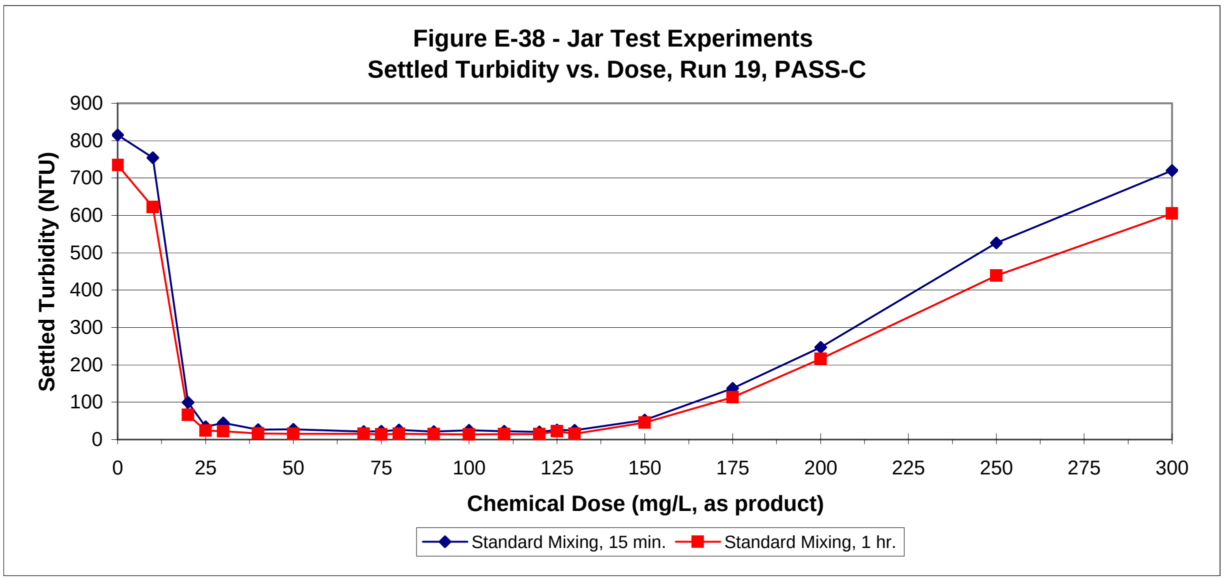


Figure E-38 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 19, PASS-C
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

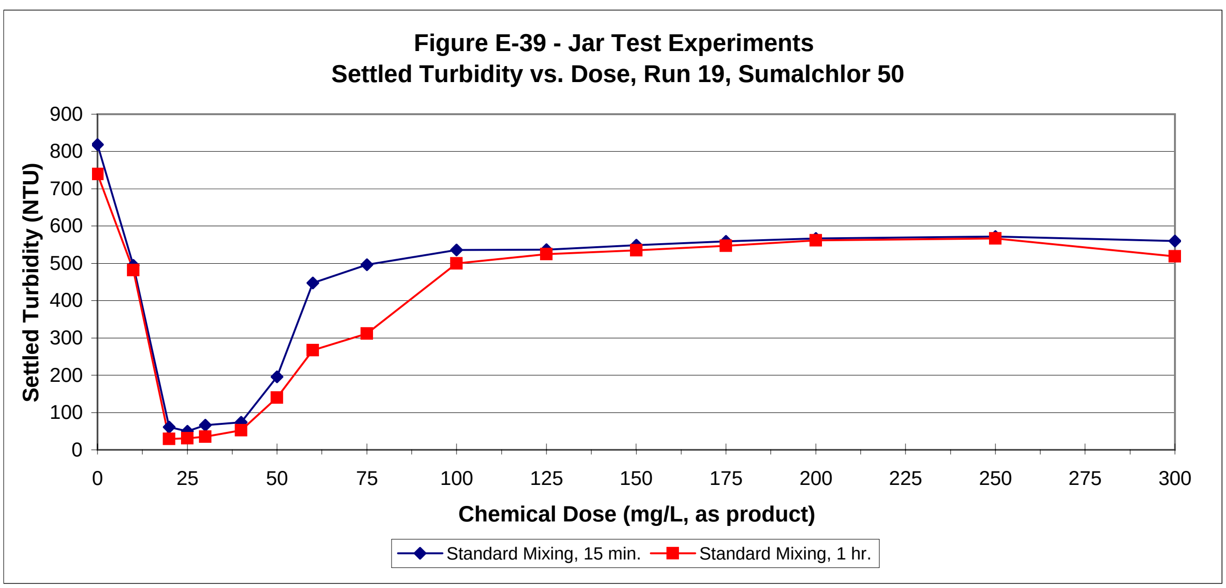


Figure E-39 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 19, Sumalchlor 50
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

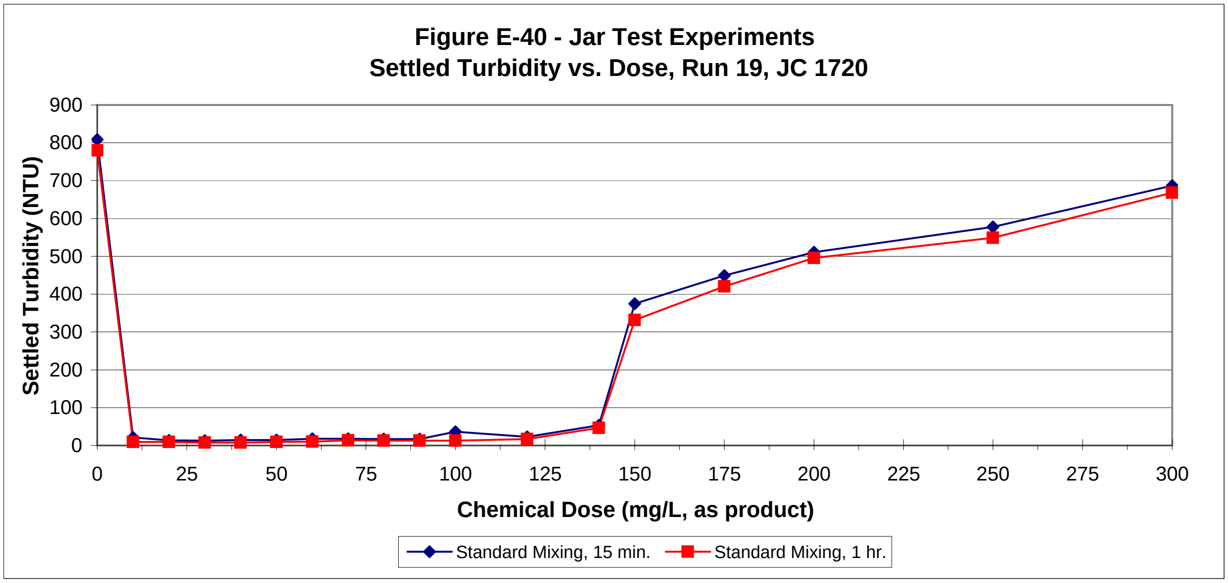


Figure E-40 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 19, JC 1720
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

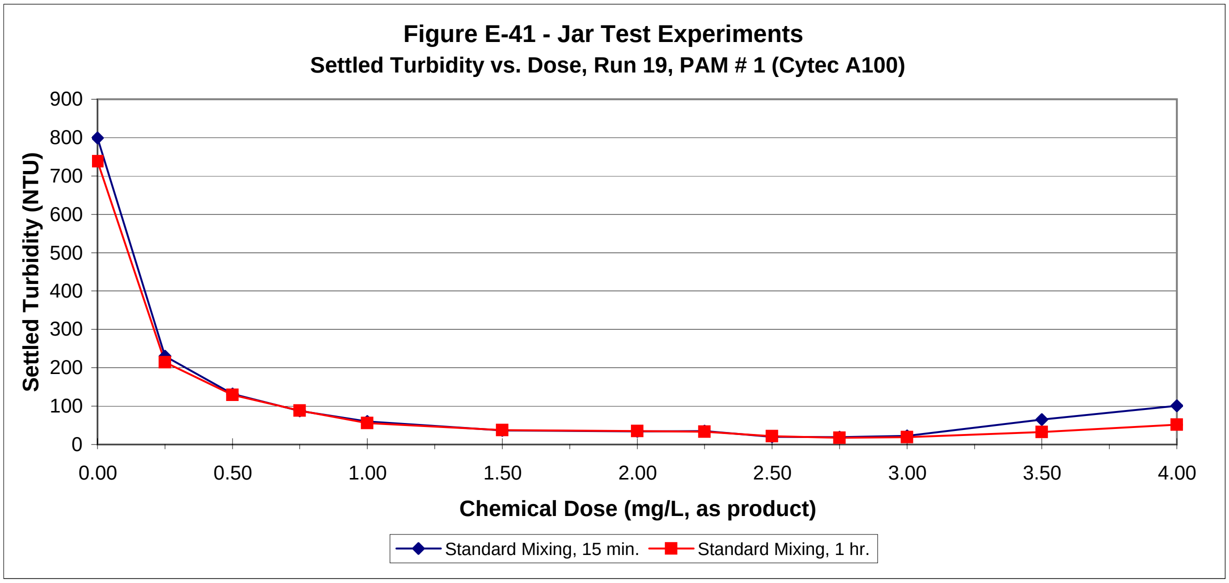


Figure E-41 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 19, PAM # 1 (Cytec A100)
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

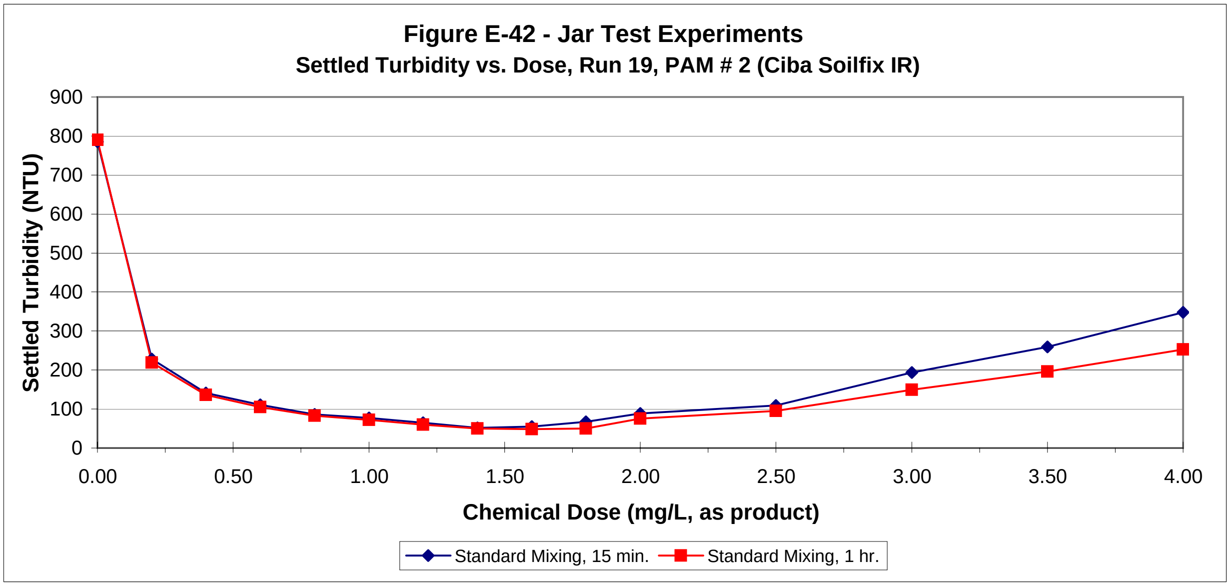


Figure E-42 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 19, PAM # 2 (Ciba Soilfix IR)
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

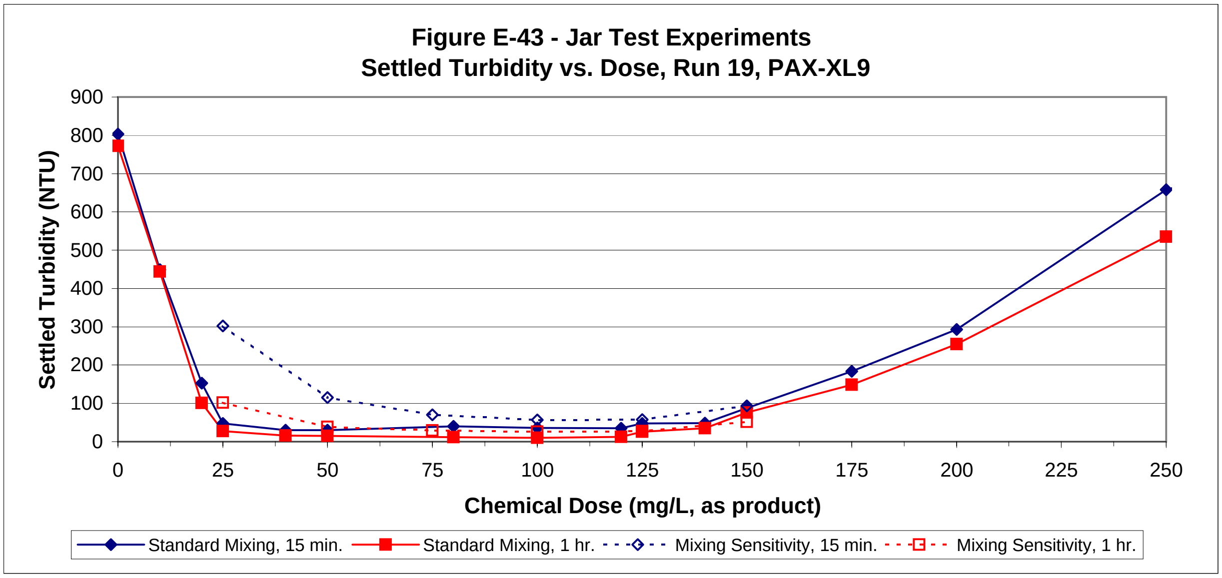


Figure E-43 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 19, PAX-XL9
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

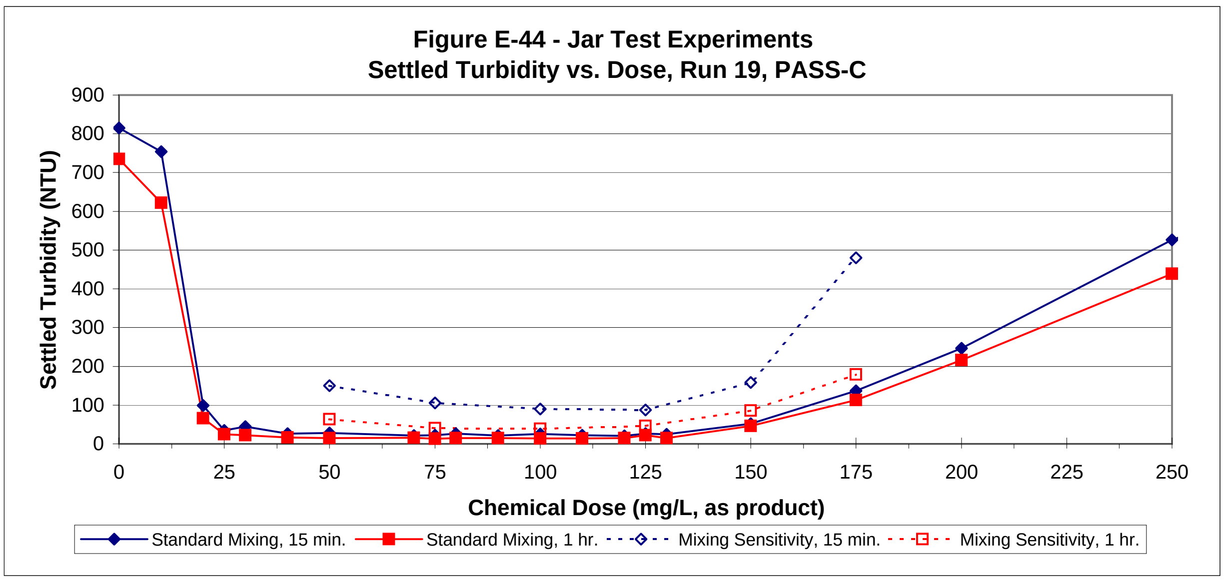


Figure E-44 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 19, PASS-C
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

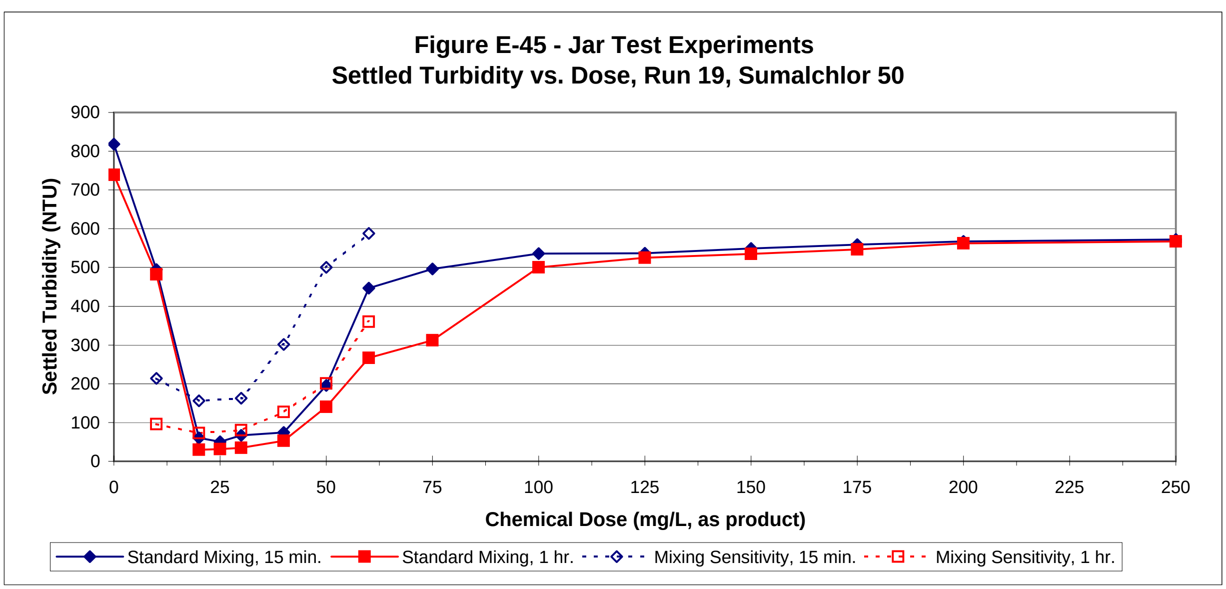


Figure E-45 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 19, Sumalchlor 50
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

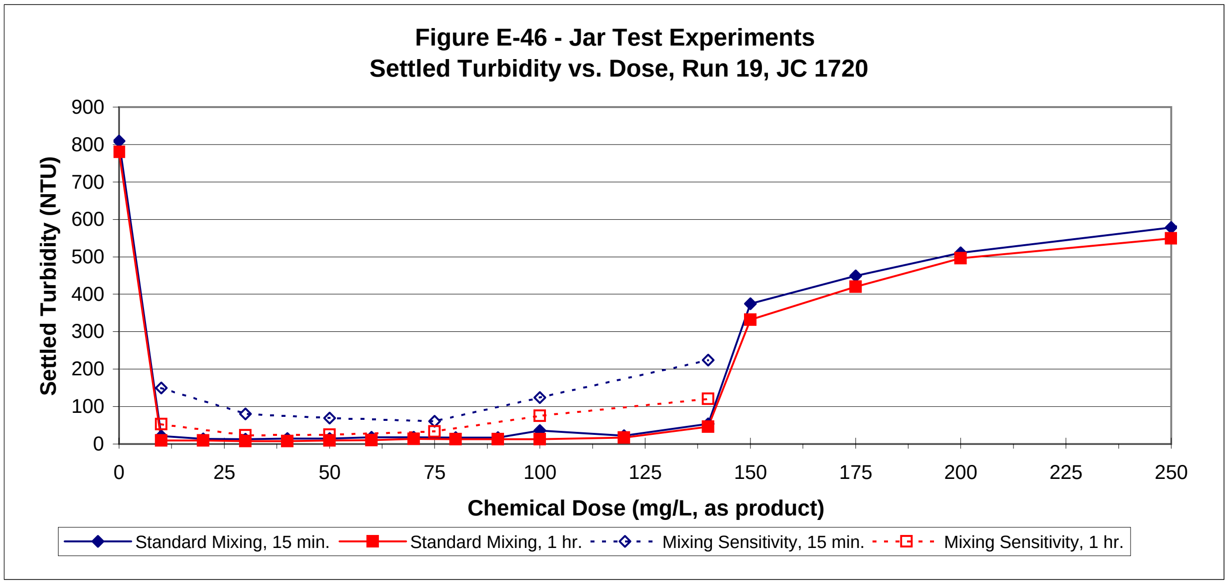


Figure E-46 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 19, JC 1720
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

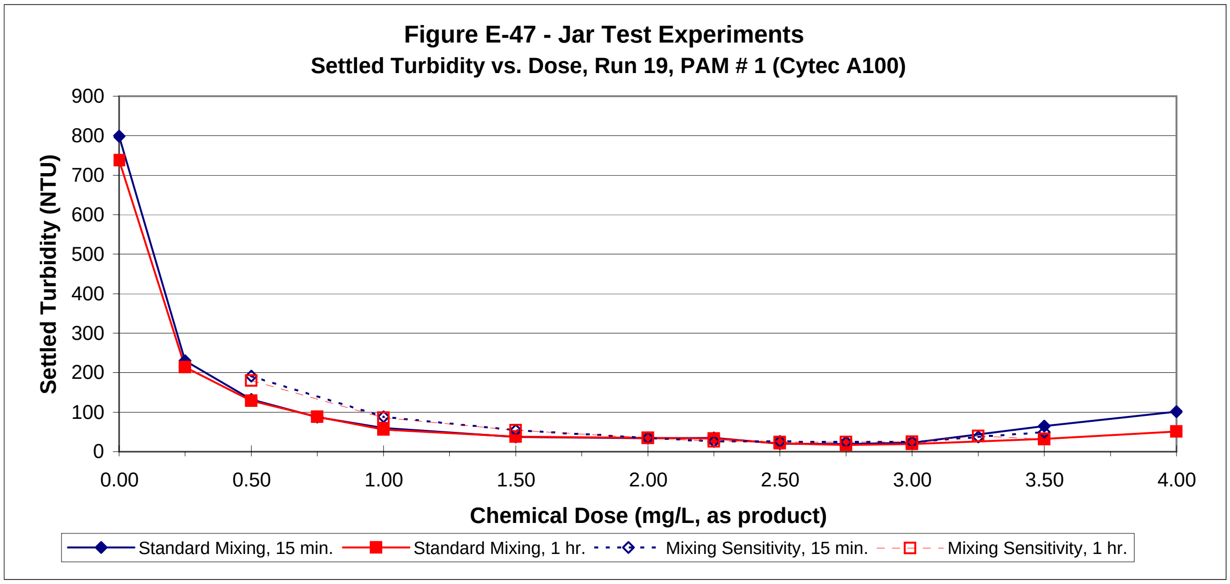


Figure E-47 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 19, PAM # 1 (Cytec A100)
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

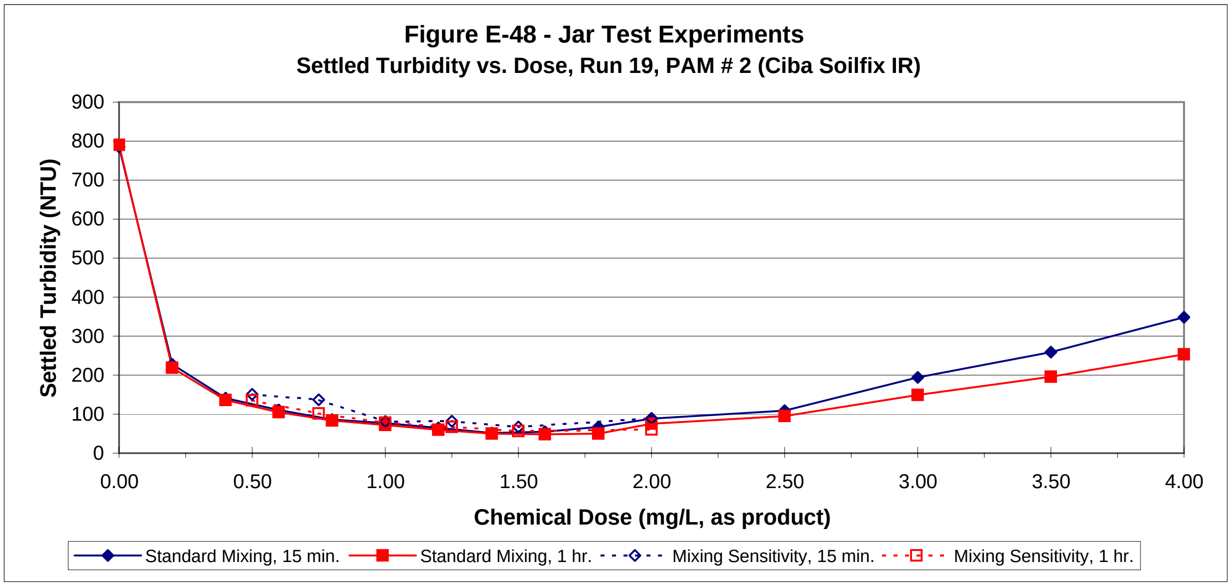


Figure E-48 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 19, PAM # 2 (Ciba Soilfix IR)
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

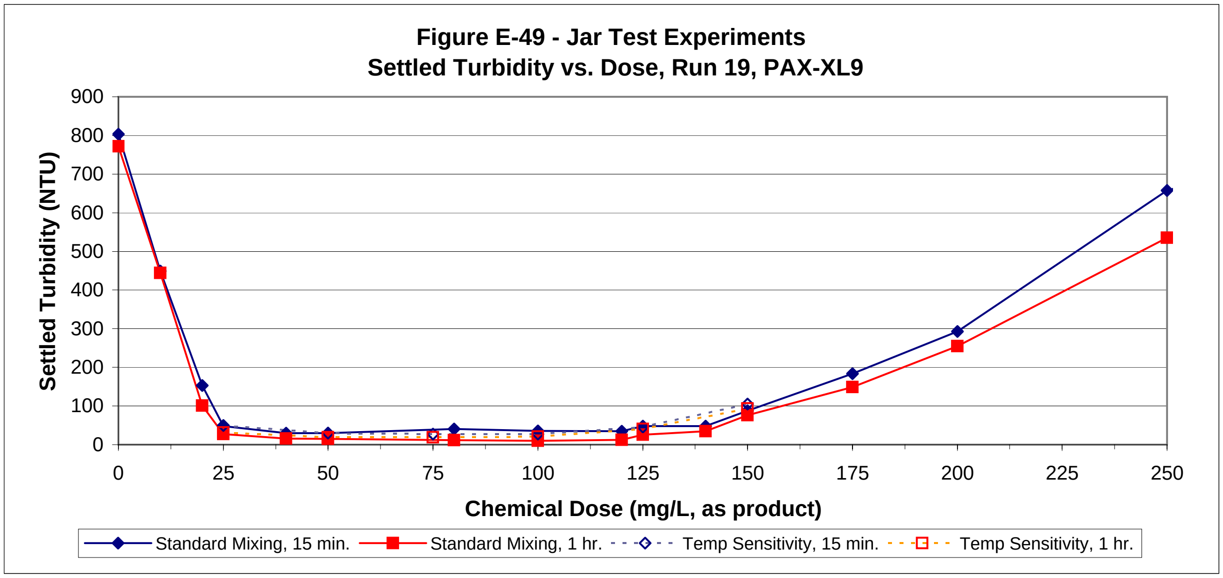


Figure E-49 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 19, PAX-XL9
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Temp Sensitivity, 15 min.
Temp Sensitivity, 1 hr.

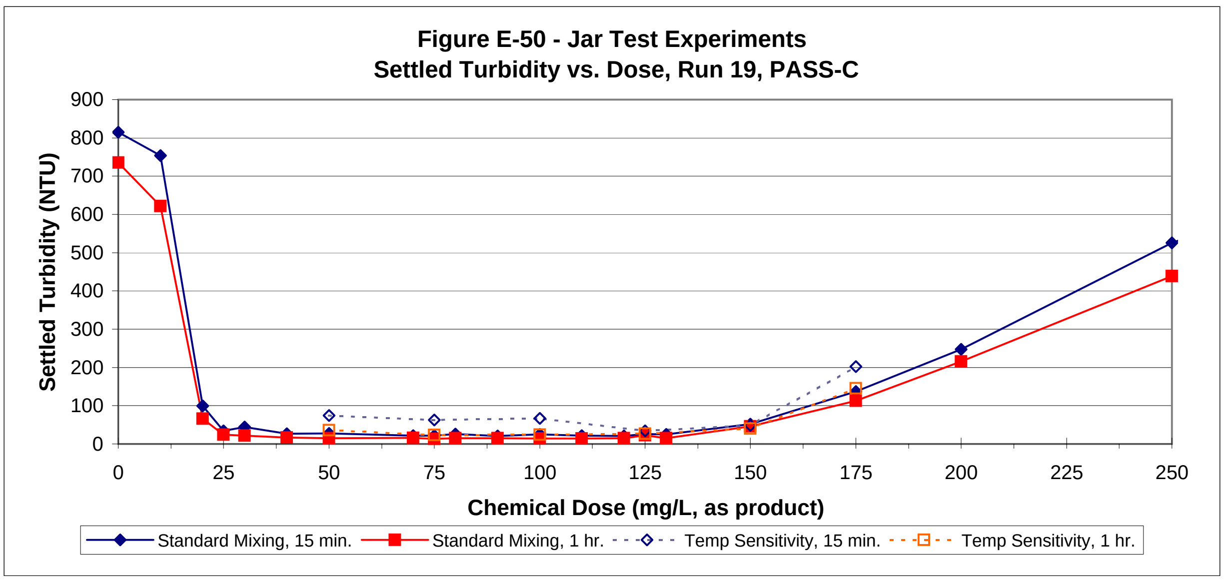


Figure E-50 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 19, PASS-C
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Temp Sensitivity, 15 min.
Temp Sensitivity, 1 hr.

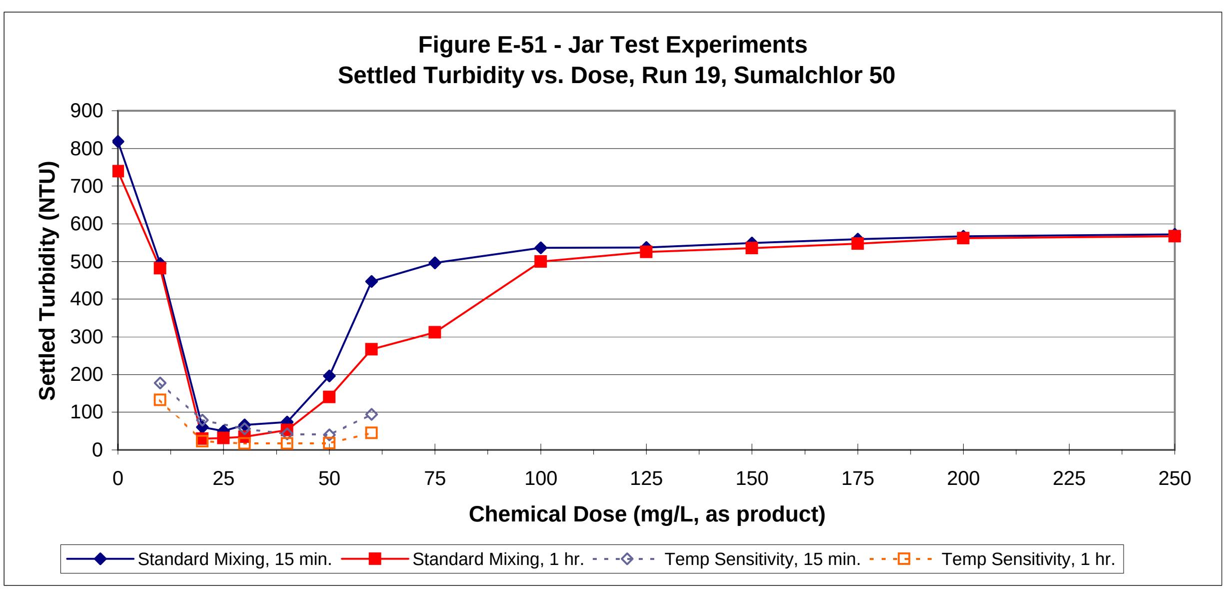


Figure E-51 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 19, Sumalchlor 50
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Temp Sensitivity, 15 min.
Temp Sensitivity, 1 hr.

Figure E-52 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 19, JC 1720

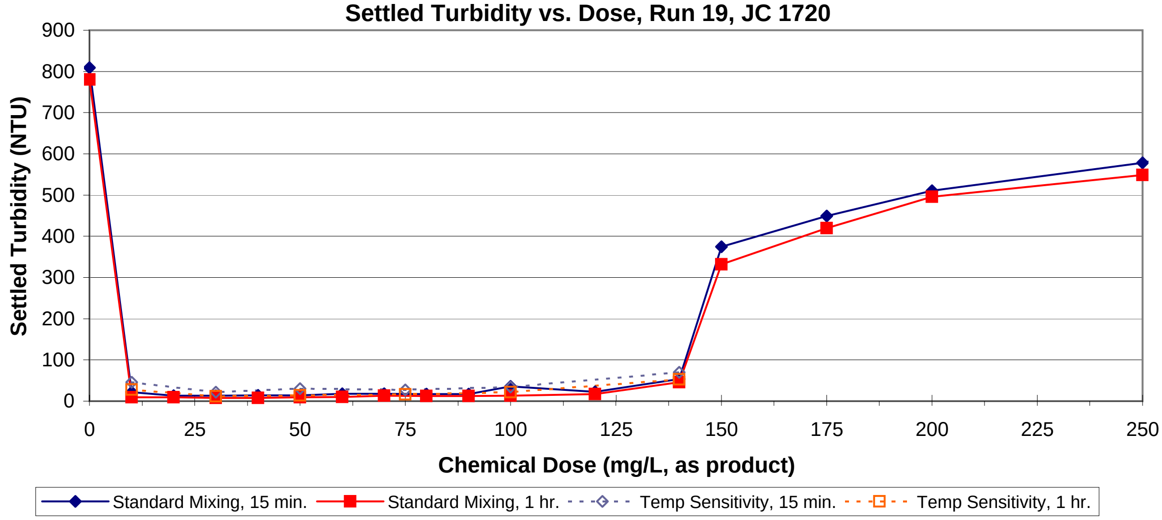


Figure E-53 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 19, PAM # 1 (Cytec A100)

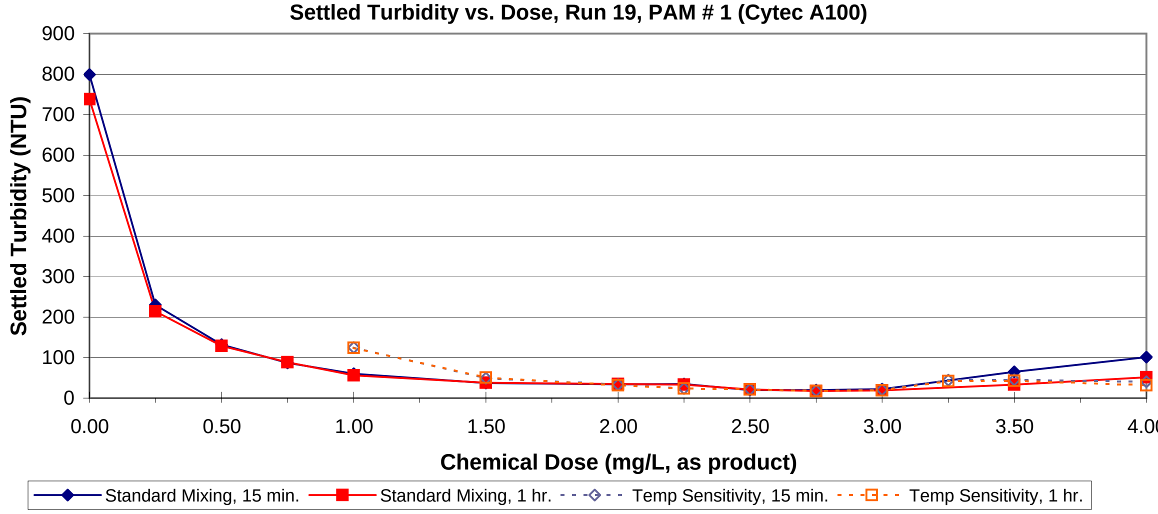
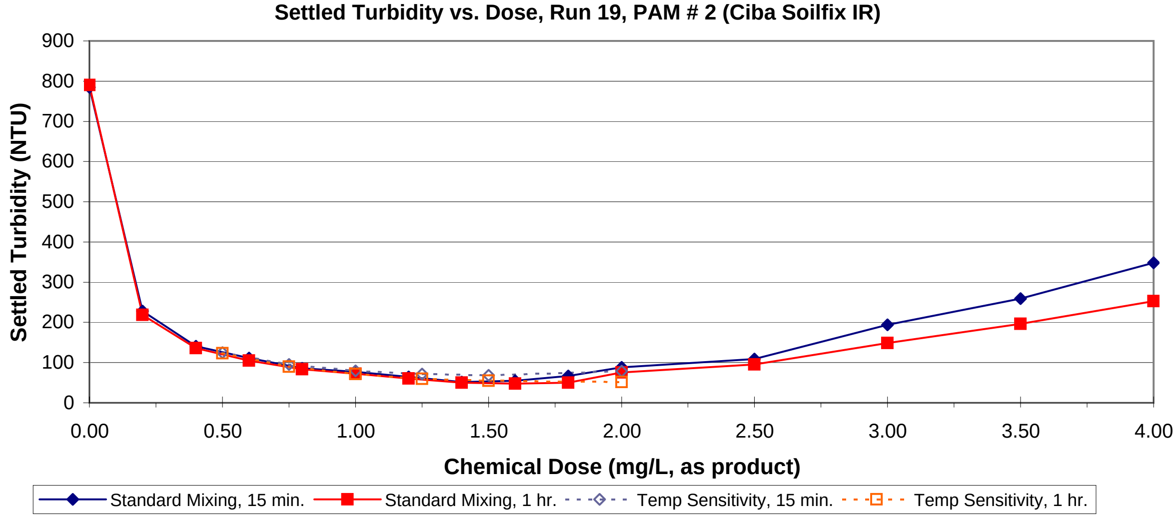


Figure E-54 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 19, PAM # 2 (Ciba Soilfix IR)



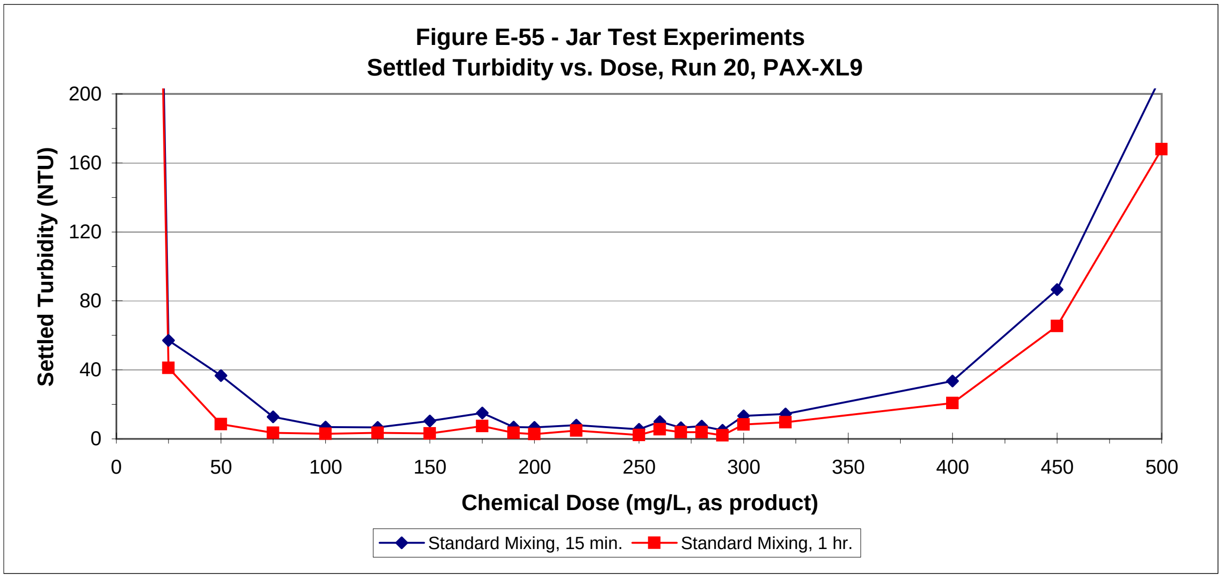


Figure E-55 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 20, PAX-XL9
Settled Turbidity (NTU)
0
40
80
120
160
200
0
50
100
150
200
250
300
350
400
450
500
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

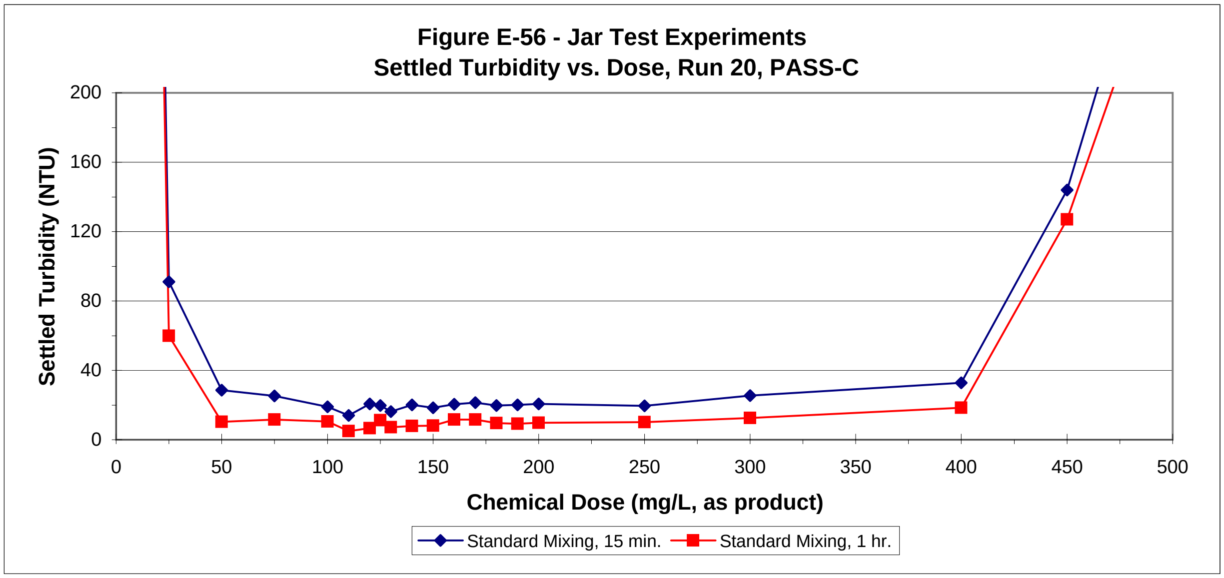


Figure E-56 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 20, PASS-C
Settled Turbidity (NTU)
0
40
80
120
160
200
0
50
100
150
200
250
300
350
400
450
500
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

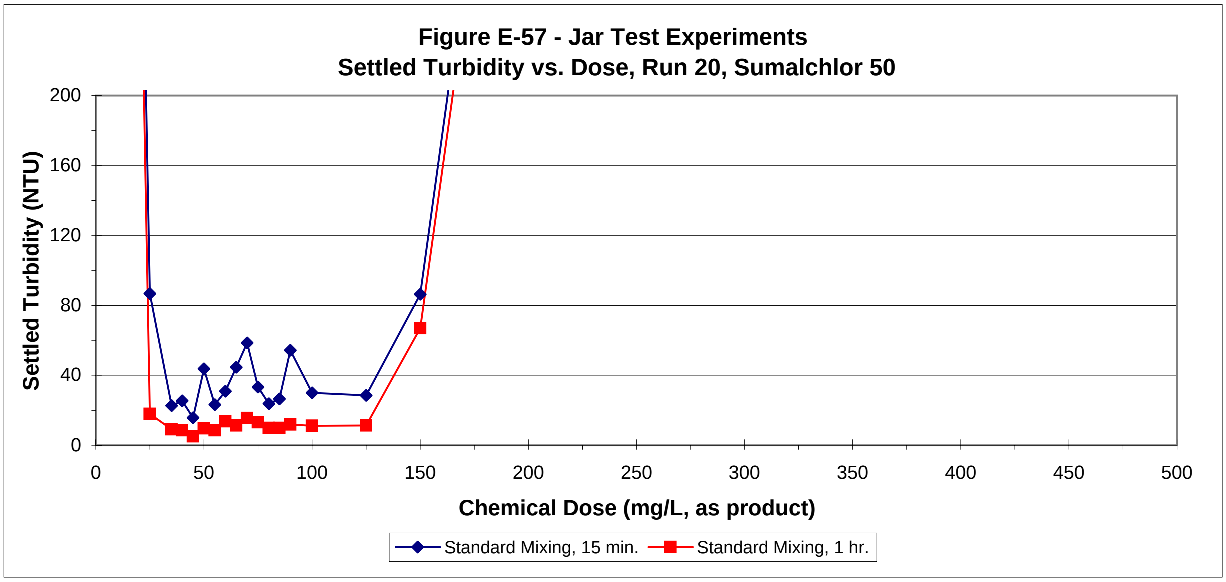


Figure E-57 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 20, Sumalchlor 50
Settled Turbidity (NTU)
0
40
80
120
160
200
0
50
100
150
200
250
300
350
400
450
500
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

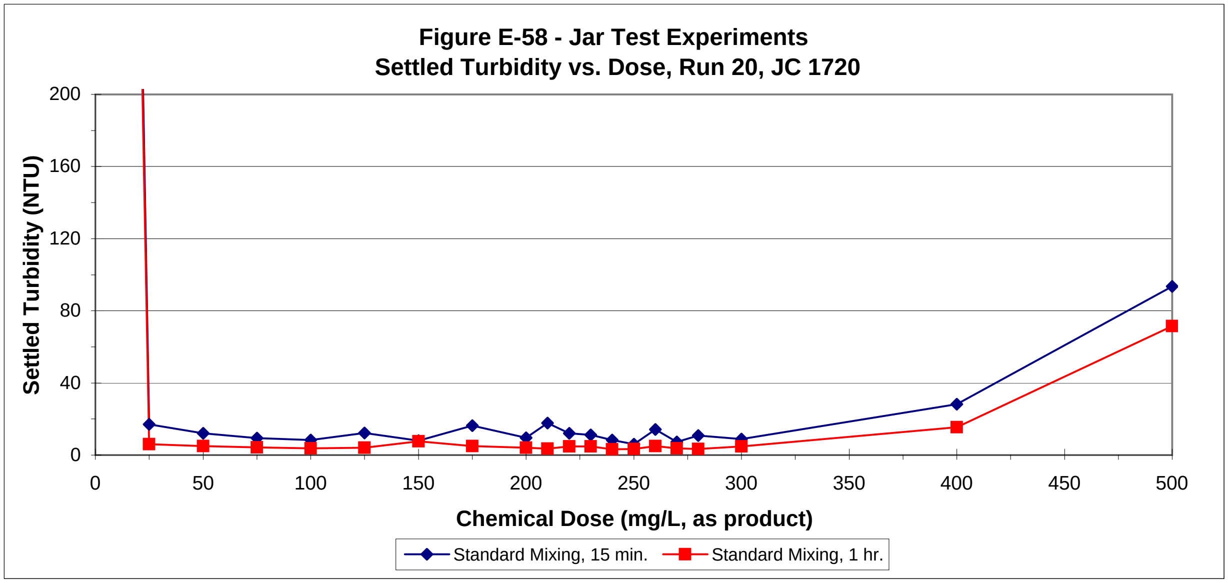


Figure E-58 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 20, JC 1720
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

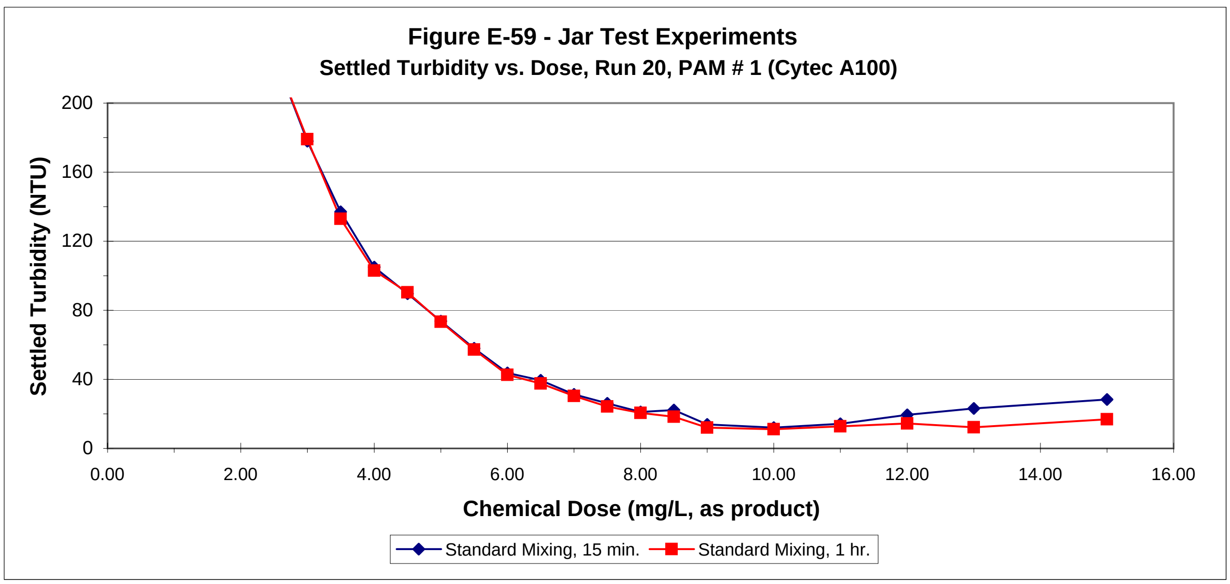


Figure E-59 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 20, PAM # 1 (Cytec A100)
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

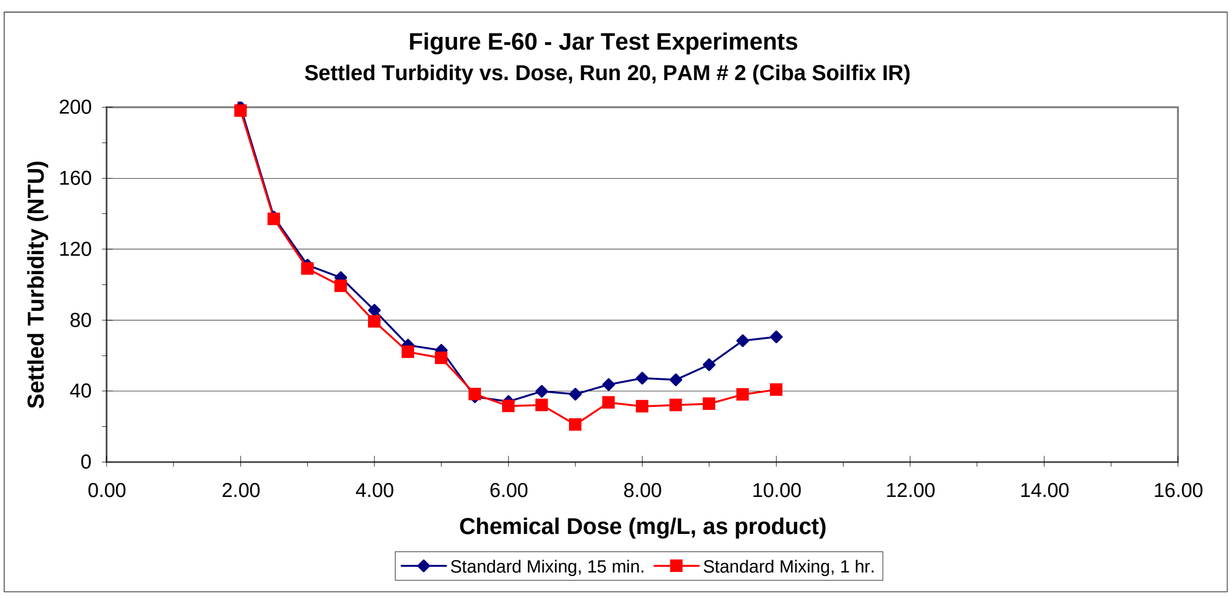


Figure E-60 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 20, PAM # 2 (Ciba Soilfix IR)
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

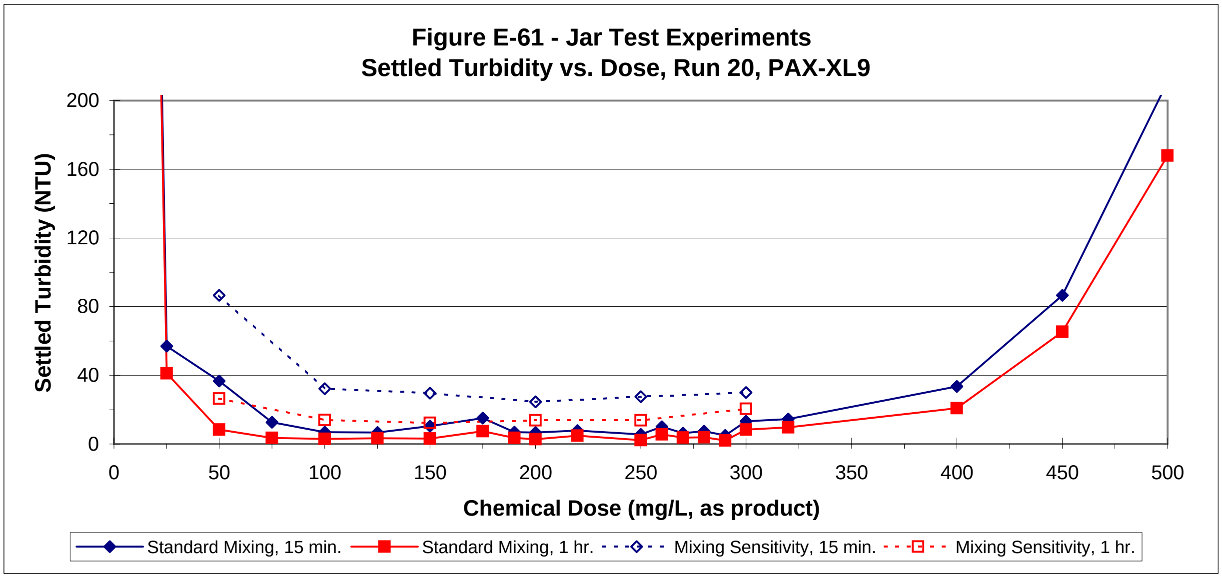


Figure E-61 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 20, PAX-XL9
Settled Turbidity (NTU)
0
40
80
120
160
200
0
50
100
150
200
250
300
350
400
450
500
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

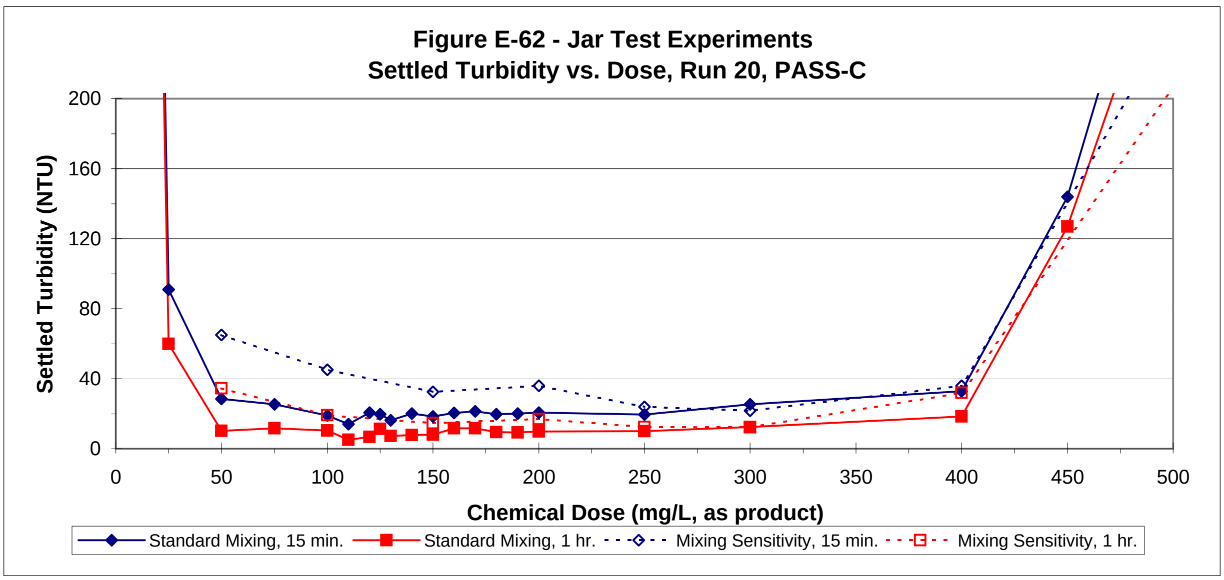


Figure E-62 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 20, PASS-C
Settled Turbidity (NTU)
0
40
80
120
160
200
0
50
100
150
200
250
300
350
400
450
500
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

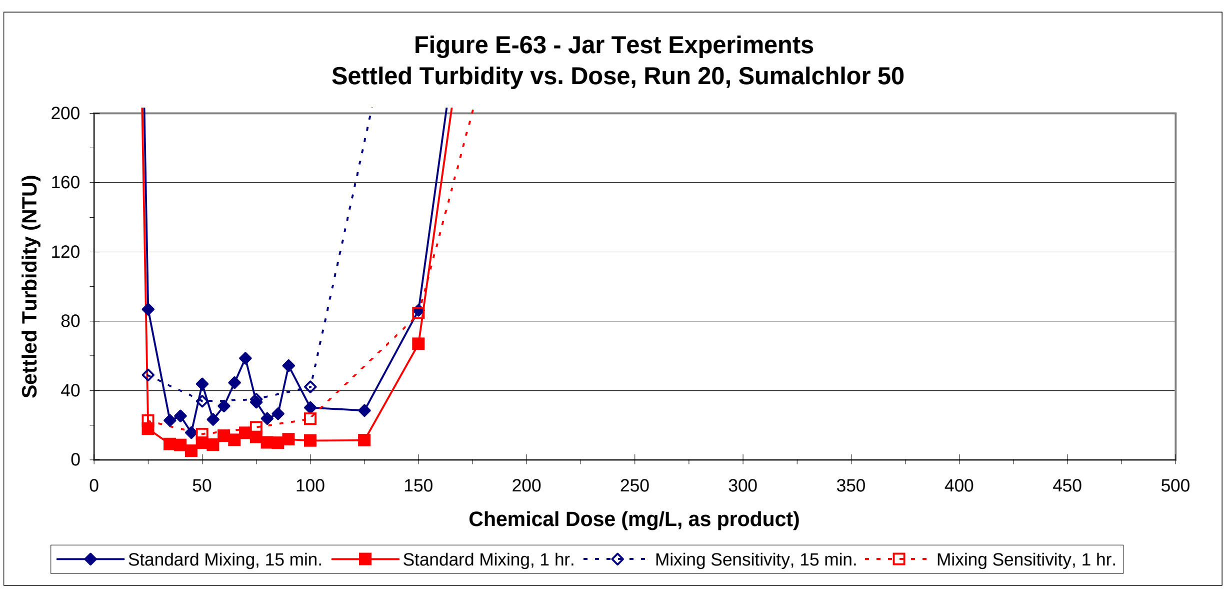


Figure E-63 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 20, Sumalchlor 50
Settled Turbidity (NTU)
0
40
80
120
160
200
0
50
100
150
200
250
300
350
400
450
500
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

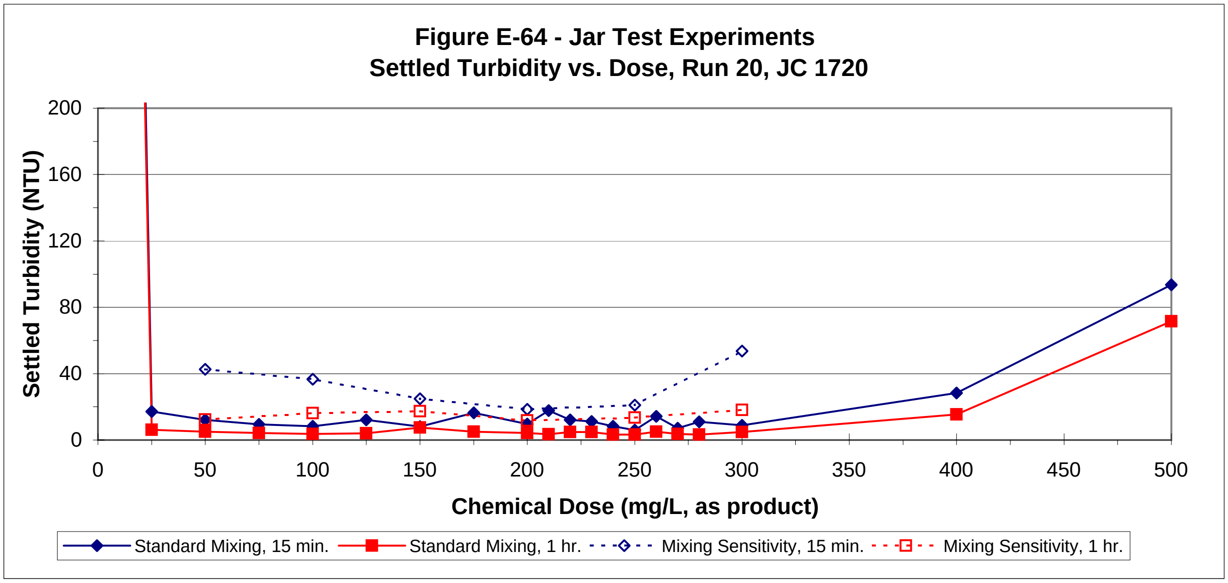


Figure E-64 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 20, JC 1720
Settled Turbidity (NTU)
0
40
80
120
160
200
0
50
100
150
200
250
300
350
400
450
500
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

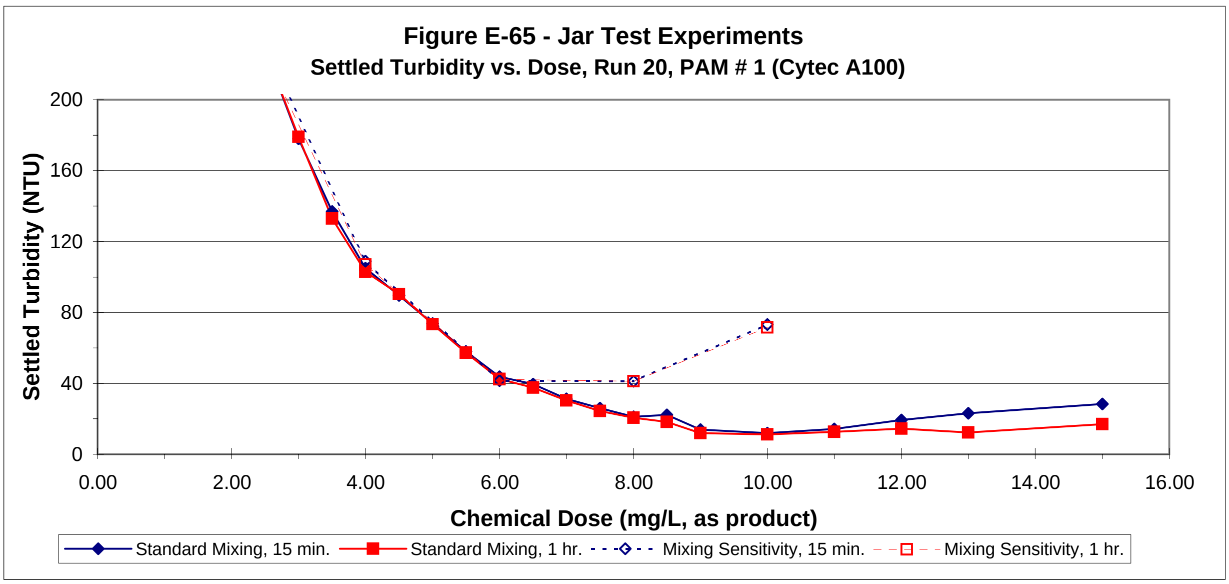


Figure E-65 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 20, PAM # 1 (Cytec A100)
Settled Turbidity (NTU)
0
40
80
120
160
200
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

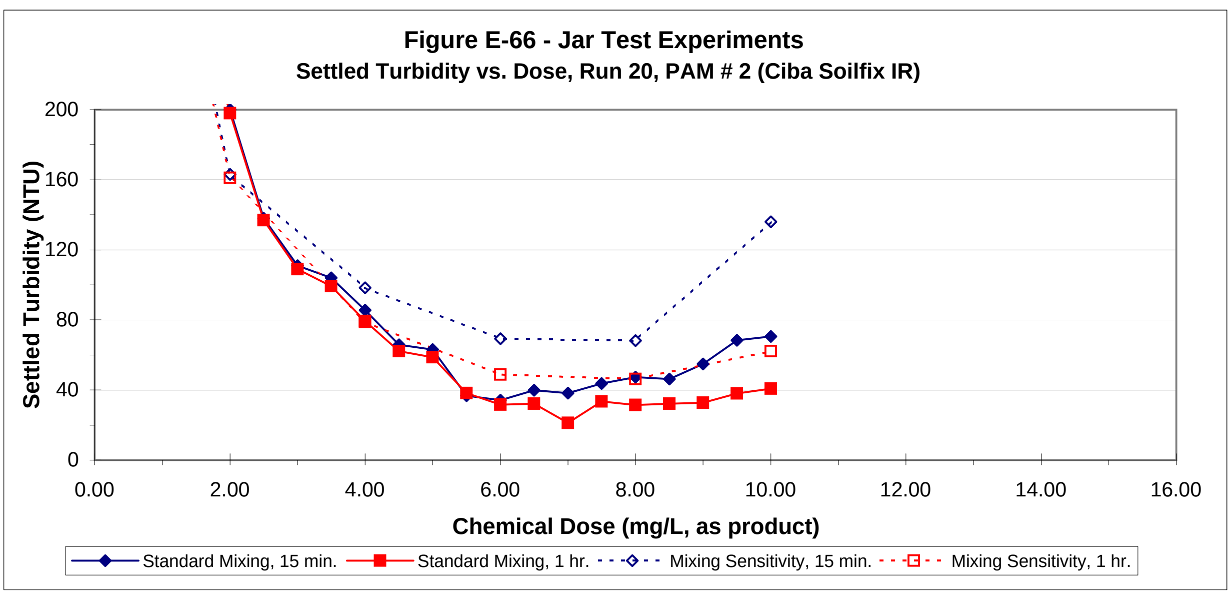


Figure E-66 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 20, PAM # 2 (Ciba Soilfix IR)
Settled Turbidity (NTU)
0
40
80
120
160
200
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

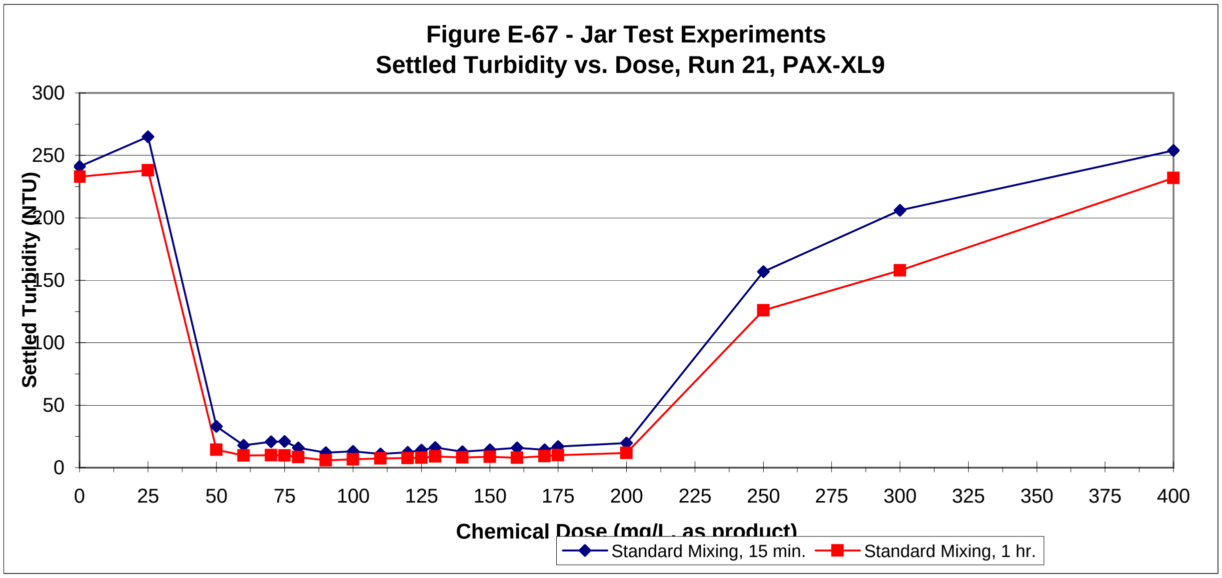


Figure E-67 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 21, PAX-XL9
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

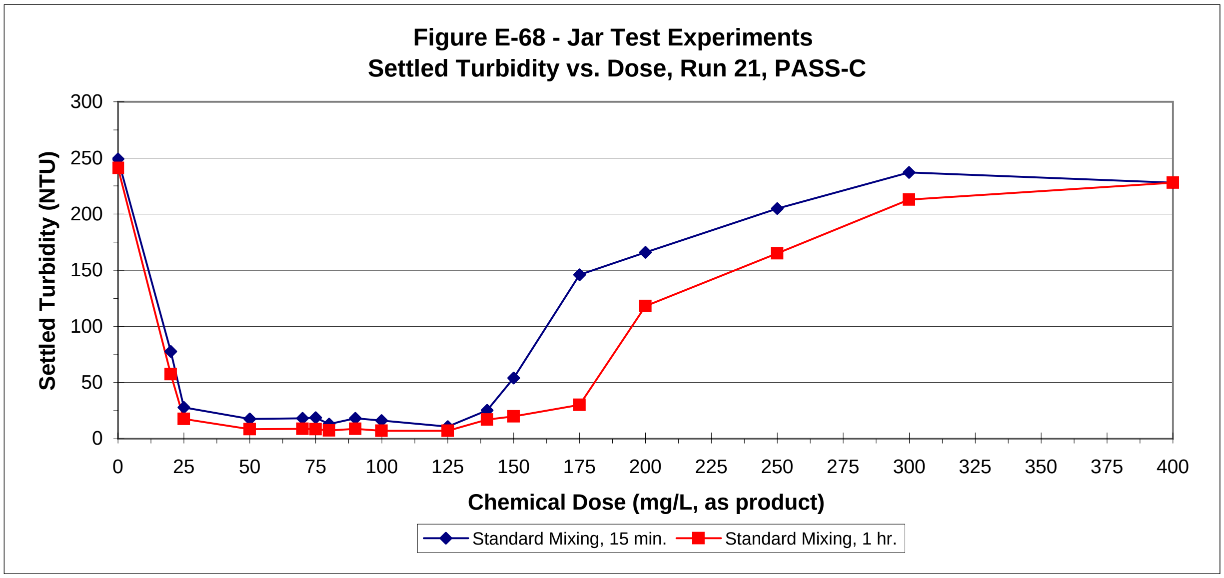


Figure E-68 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 21, PASS-C
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

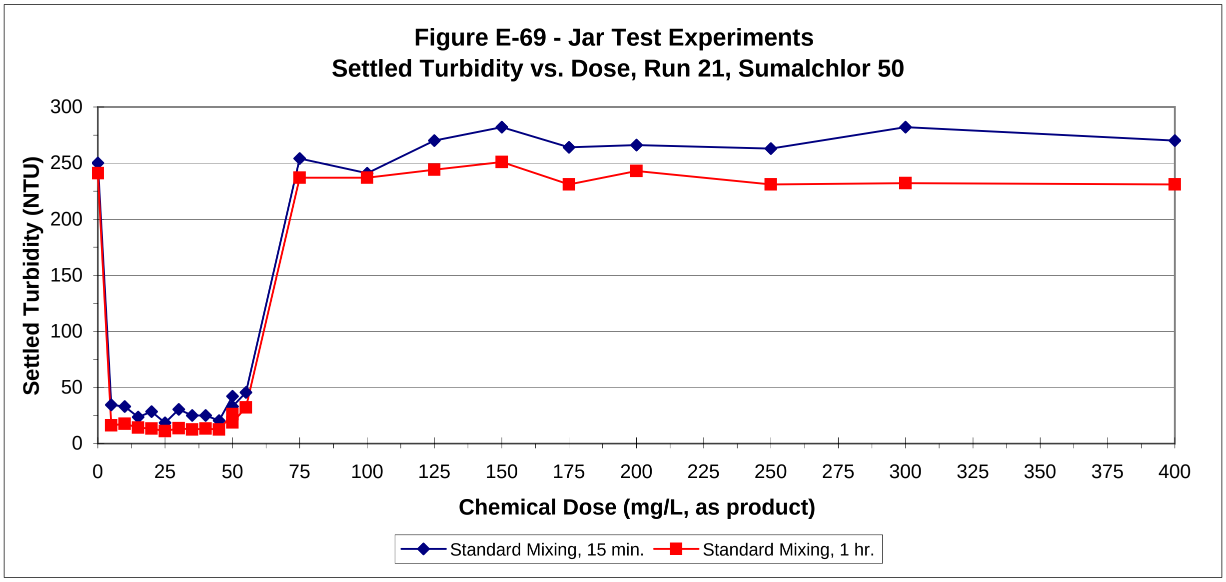


Figure E-69 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 21, Sumalchlor 50
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

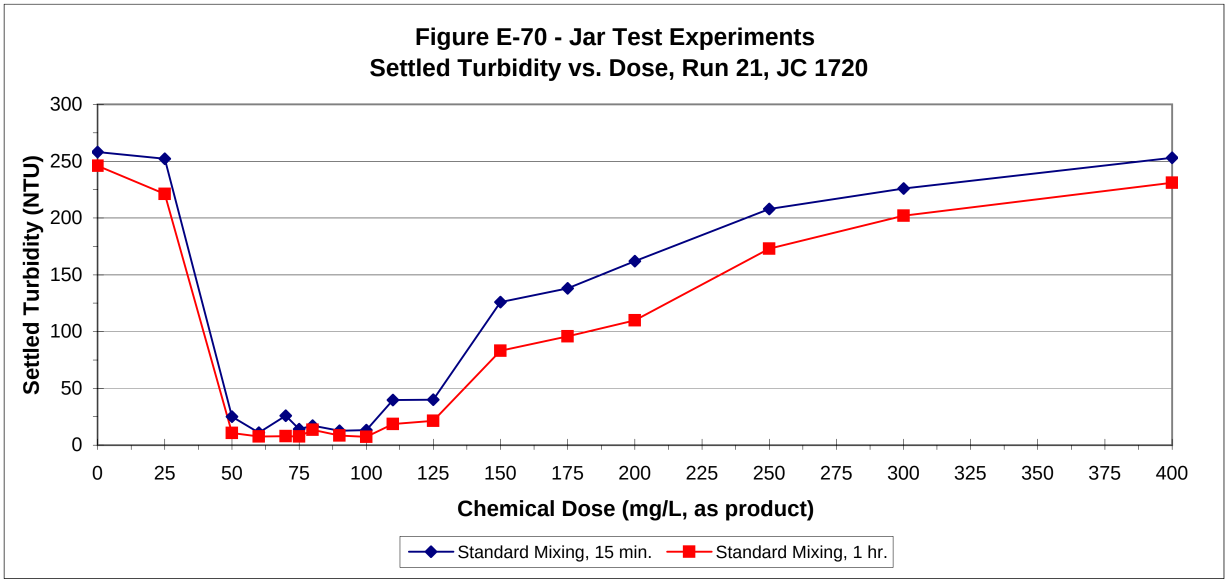


Figure E-70 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 21, JC 1720
Settled Turbidity (NTU)
0
50
100
150
200
250
300
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
375
400
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

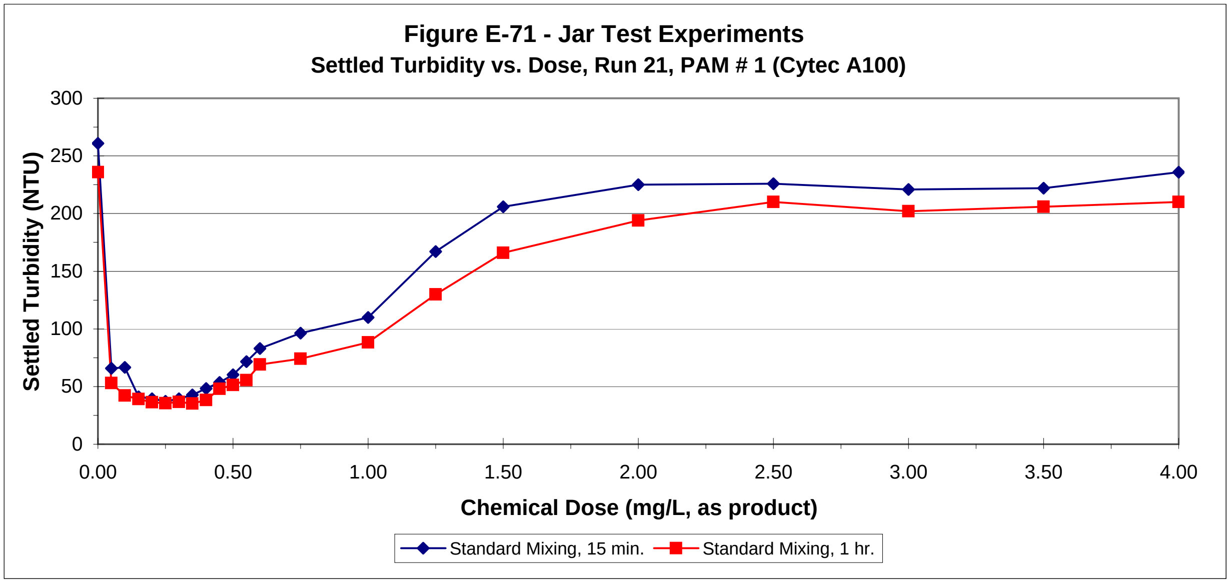


Figure E-71 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 21, PAM # 1 (Cytec A100)
Settled Turbidity (NTU)
0
50
100
150
200
250
300
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

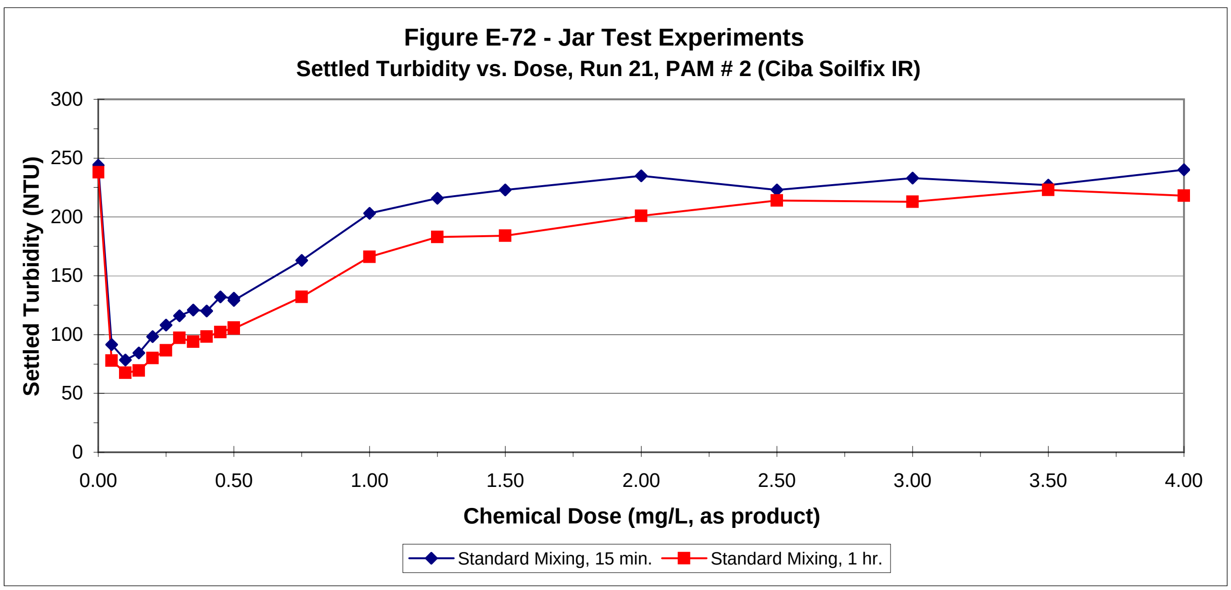


Figure E-72 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 21, PAM # 2 (Ciba Soilfix IR)
Settled Turbidity (NTU)
0
50
100
150
200
250
300
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

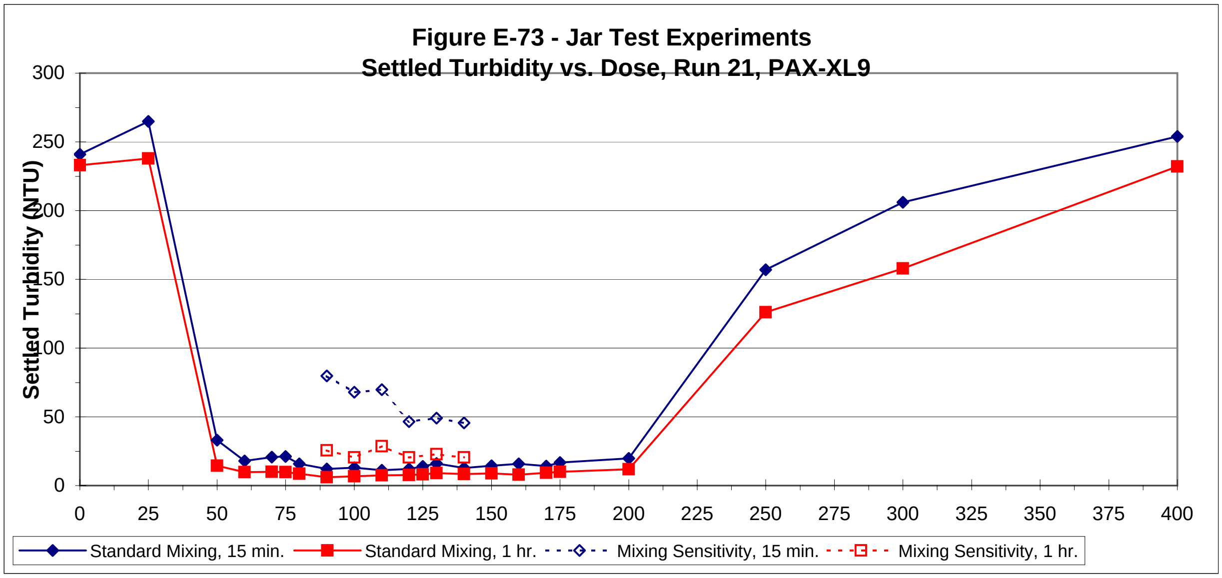


Figure E-73 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 21, PAX-XL9
Settled Turbidity (NTU)
0
50
100
150
200
250
300
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
375
400
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

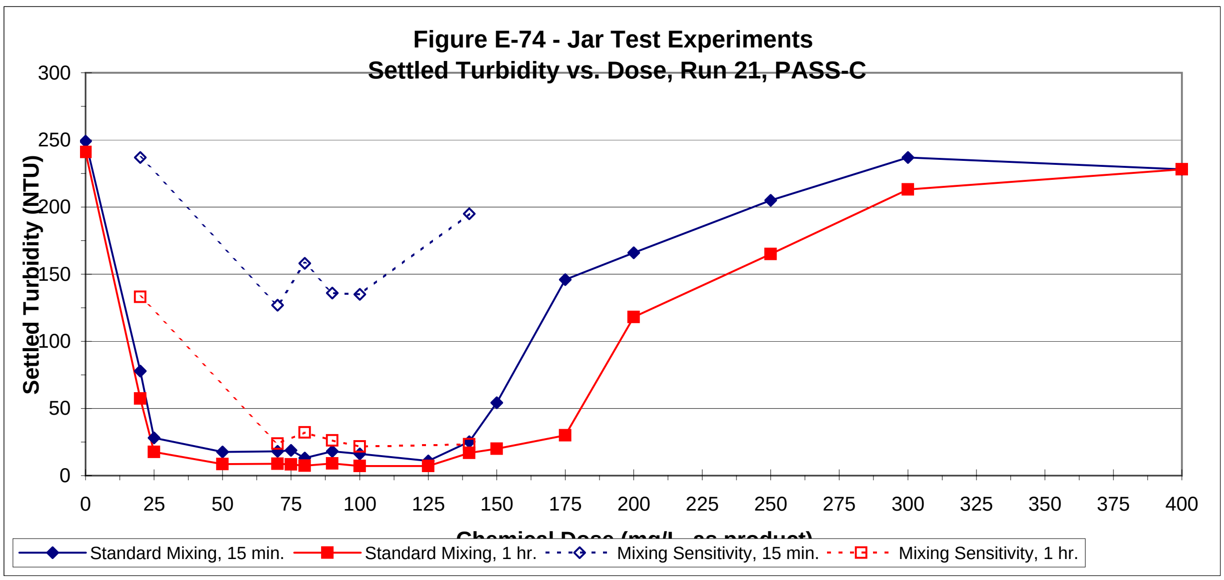


Figure E-74 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 21, PASS-C
Settled Turbidity (NTU)
0
50
100
150
200
250
300
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
375
400
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

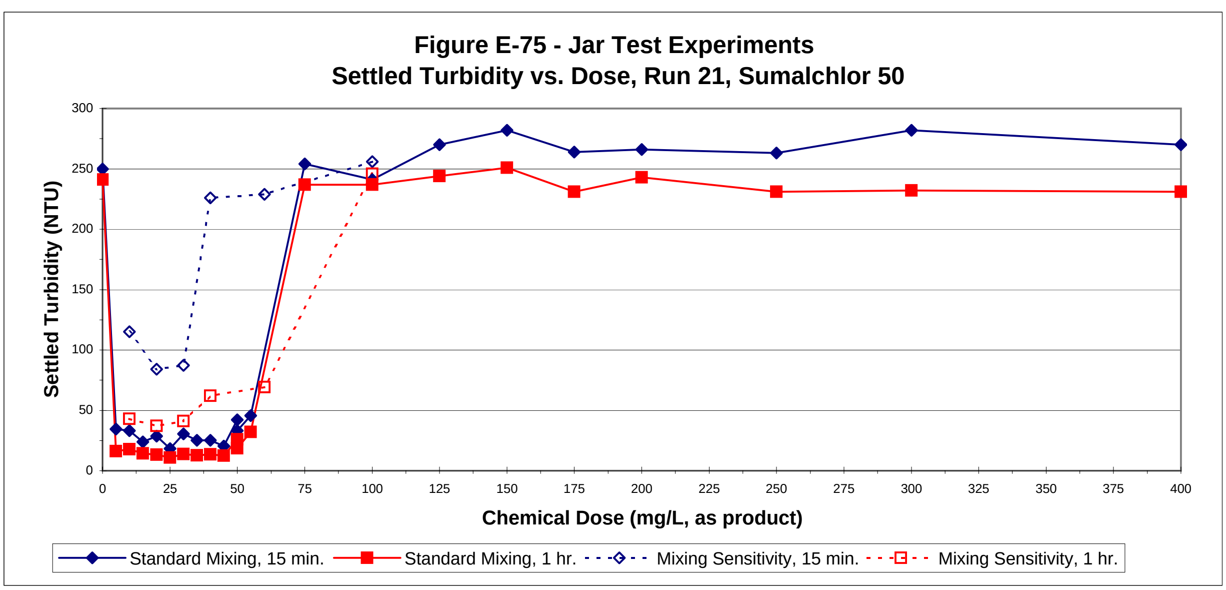


Figure E-75 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 21, Sumalchlor 50
Settled Turbidity (NTU)
0
50
100
150
200
250
300
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
375
400
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

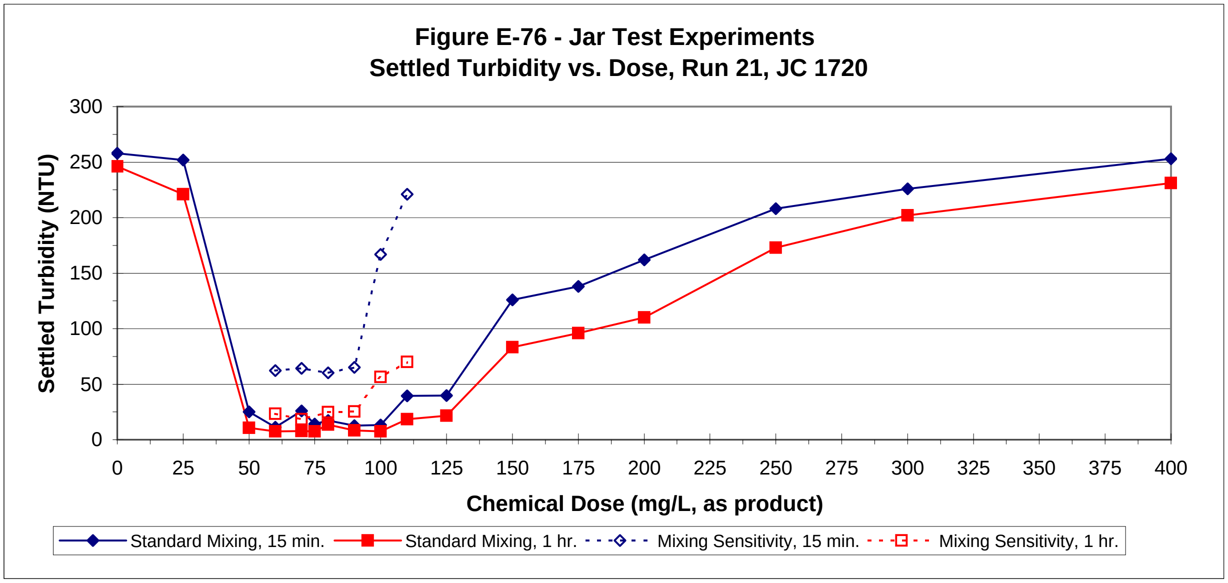


Figure E-76 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 21, JC 1720
Settled Turbidity (NTU)
0
50
100
150
200
250
300
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
375
400
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

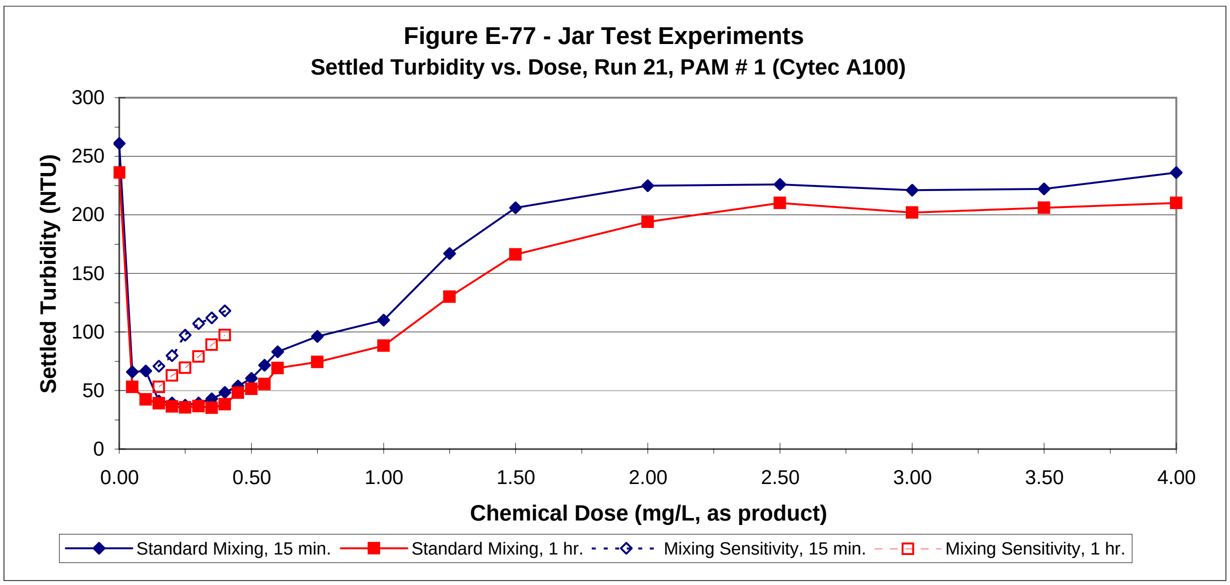


Figure E-77 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 21, PAM # 1 (Cytec A100)
Settled Turbidity (NTU)
0
50
100
150
200
250
300
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

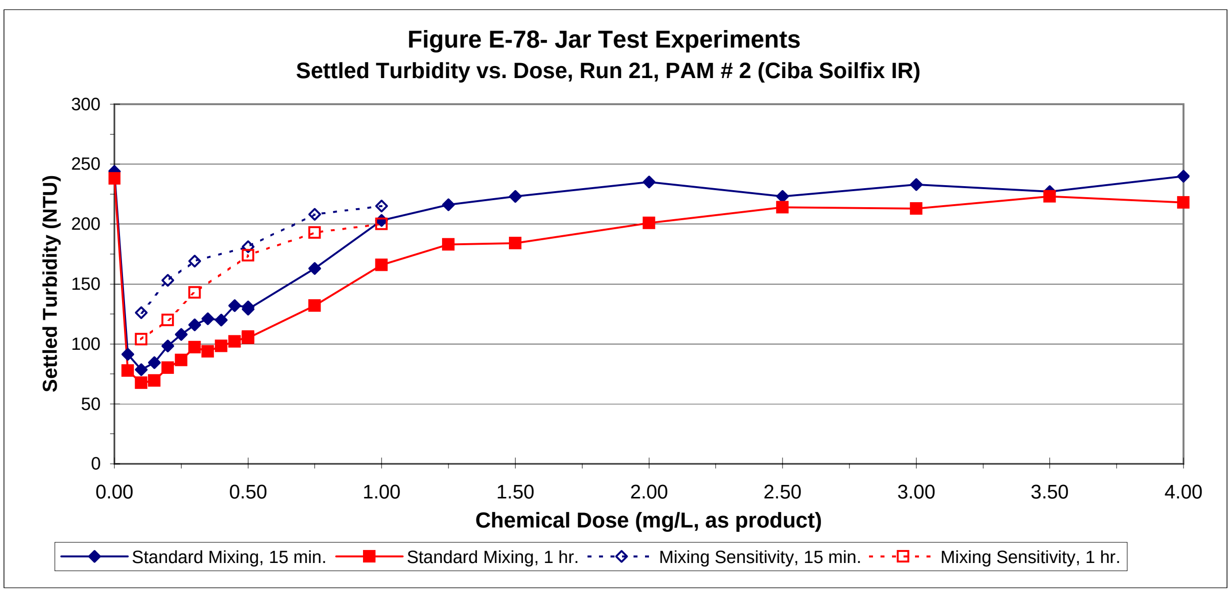


Figure E-78- Jar Test Experiments
Settled Turbidity vs. Dose, Run 21, PAM # 2 (Ciba Soilfix IR)
Settled Turbidity (NTU)
0
50
100
150
200
250
300
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

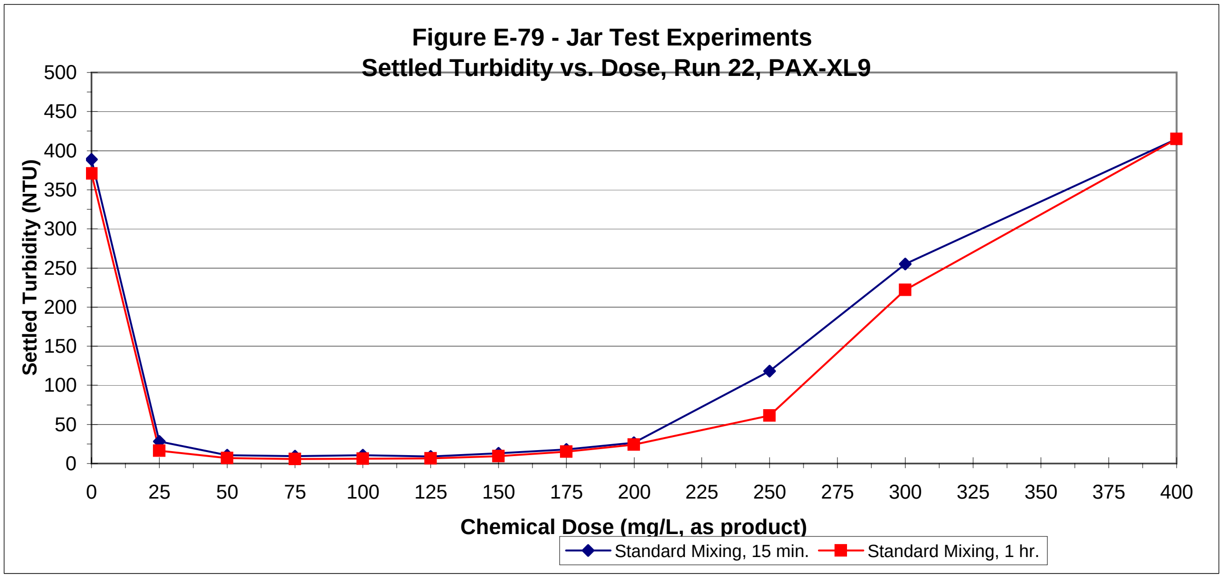


Figure E-79 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 22, PAX-XL9
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

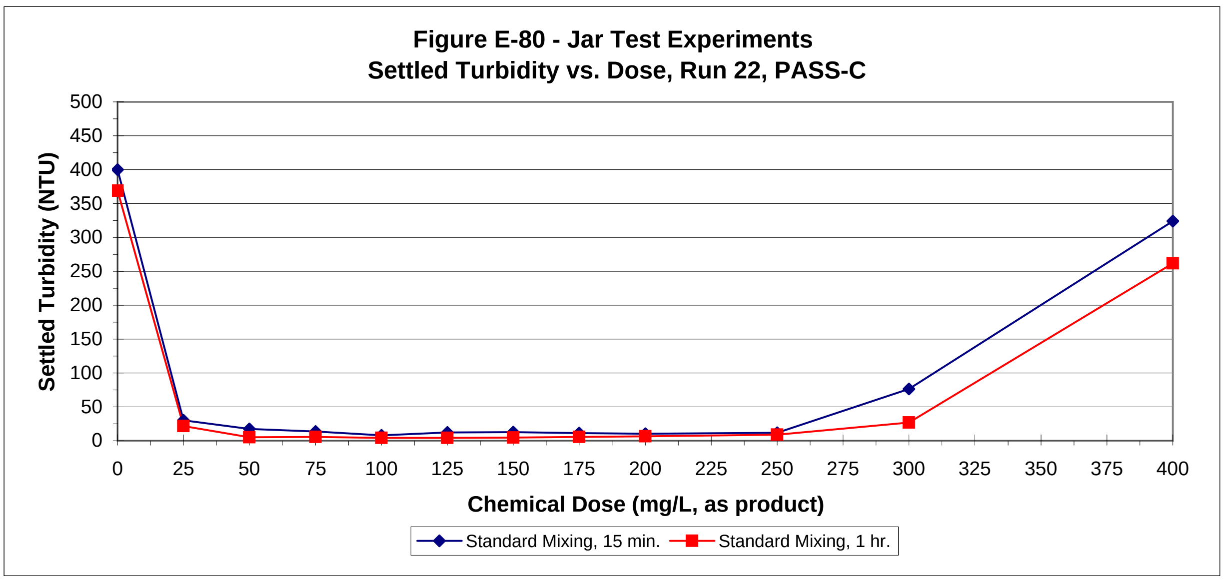


Figure E-80 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 22, PASS-C
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

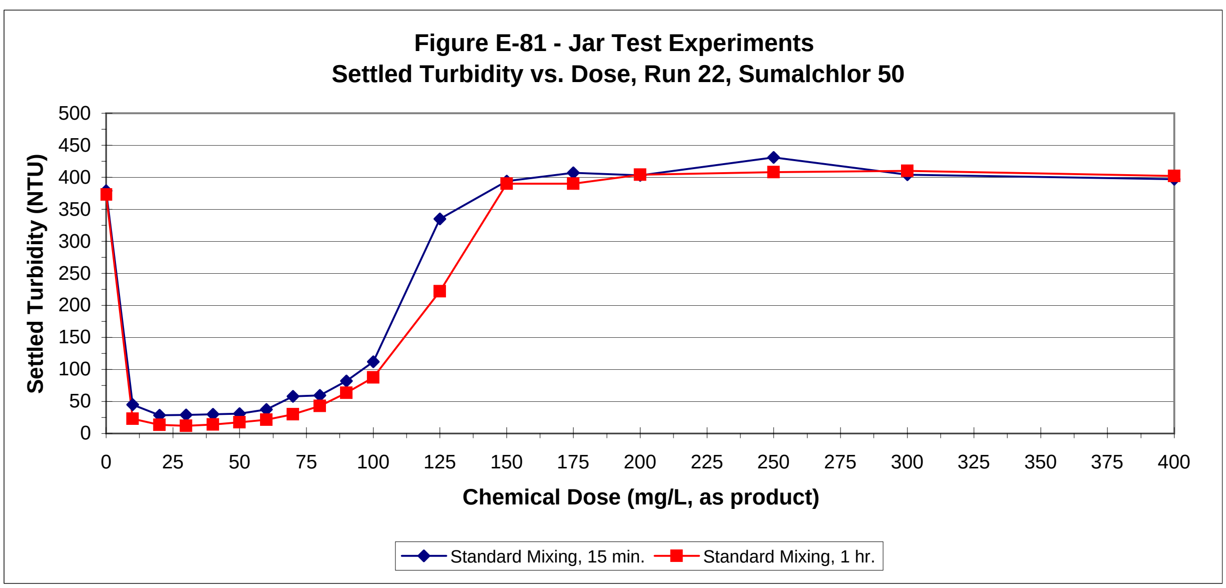


Figure E-81 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 22, Sumalchlor 50
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

Figure E-82 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 22, JC 1720

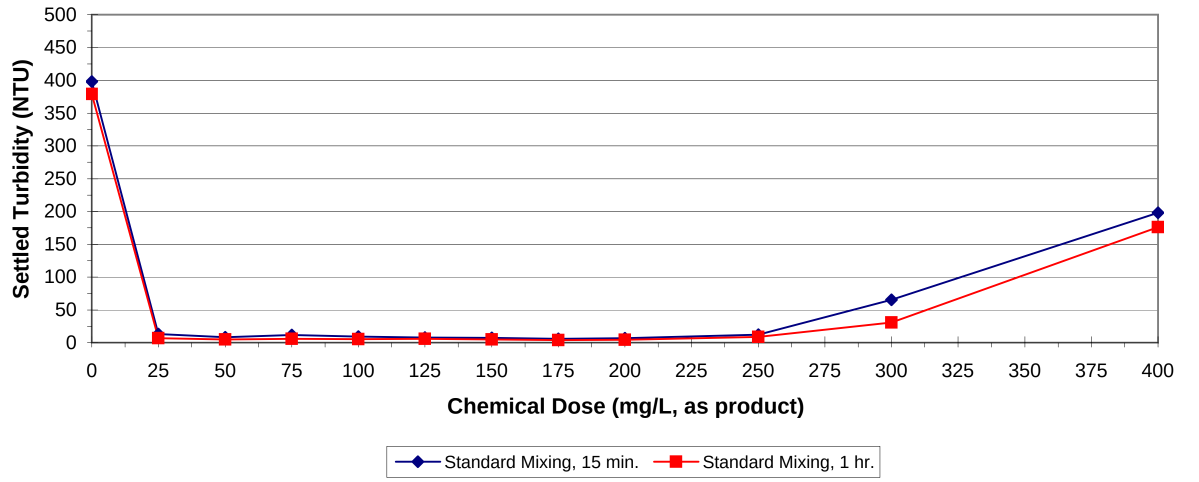


Figure E-83 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 22, PAM # 1 (Cytec A100)

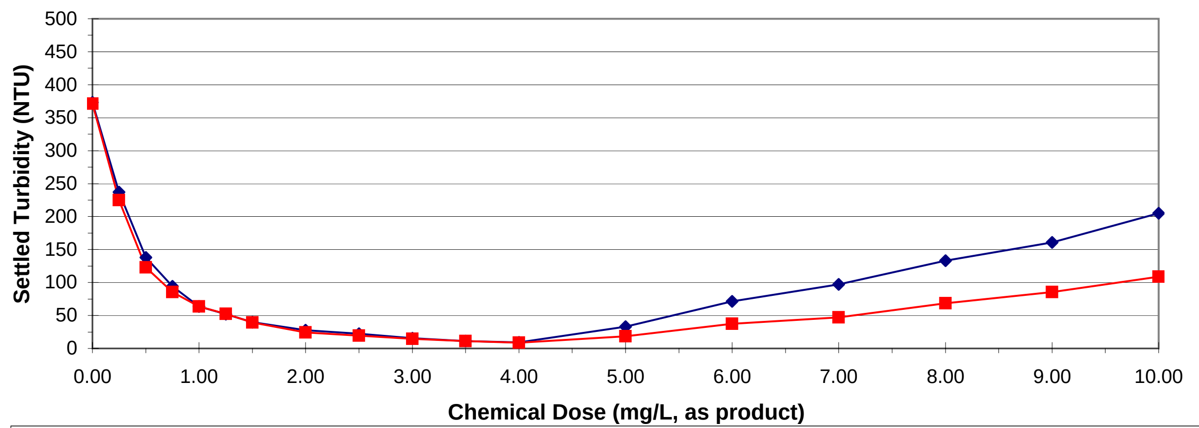


Figure E-84 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 22, PAM # 2 (Ciba Soilfix IR)

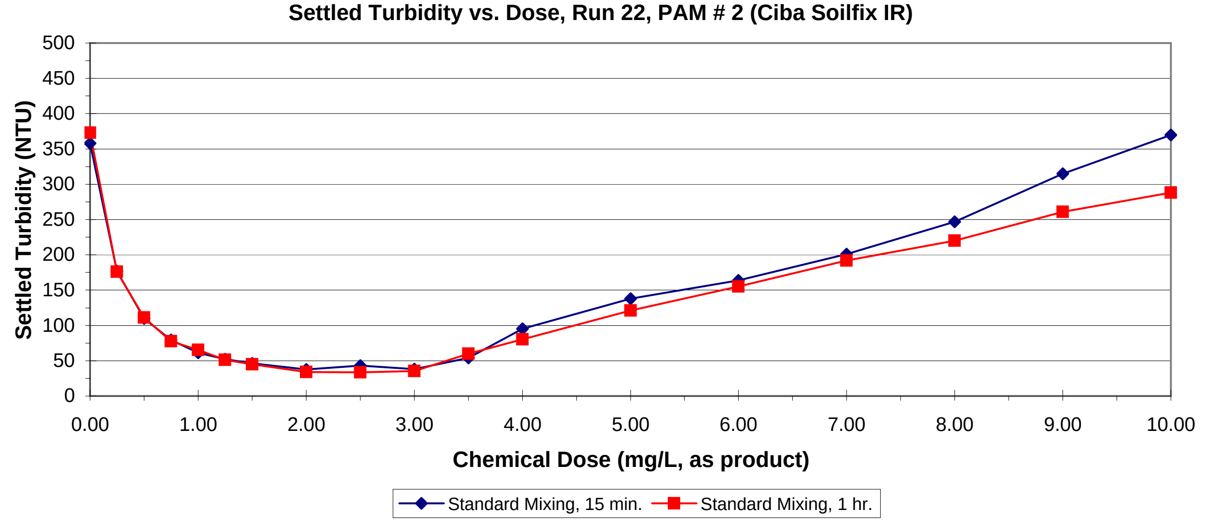


Figure E-85 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 22, PAX-XL9

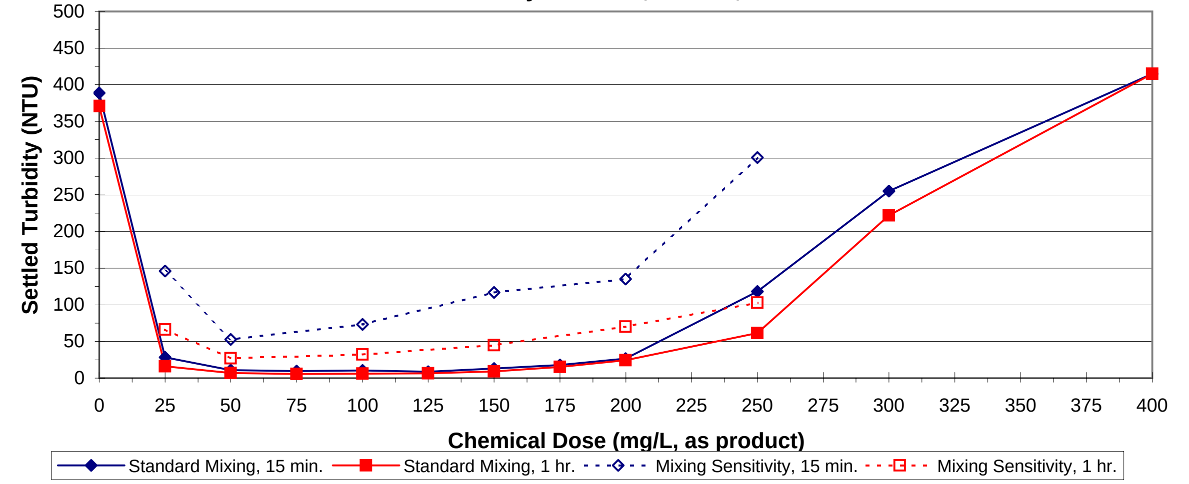


Figure E-86 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 22, PASS-C

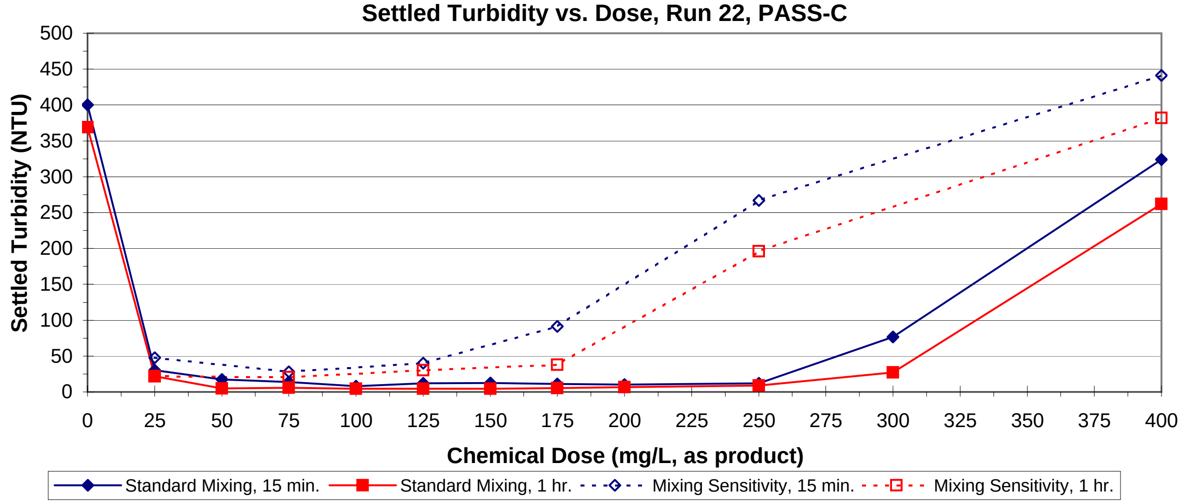
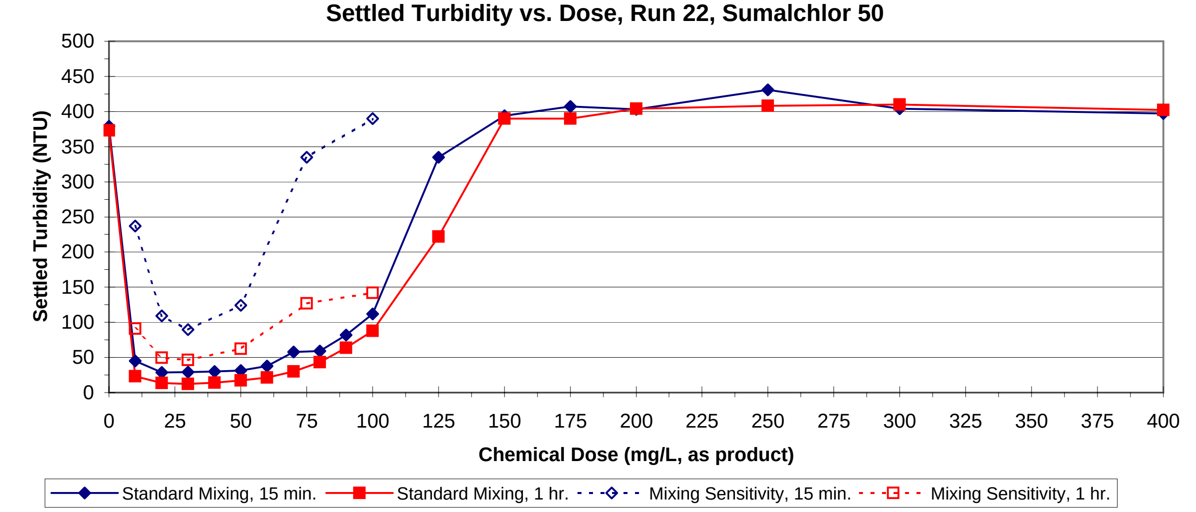


Figure E-87 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 22, Sumalchlor 50



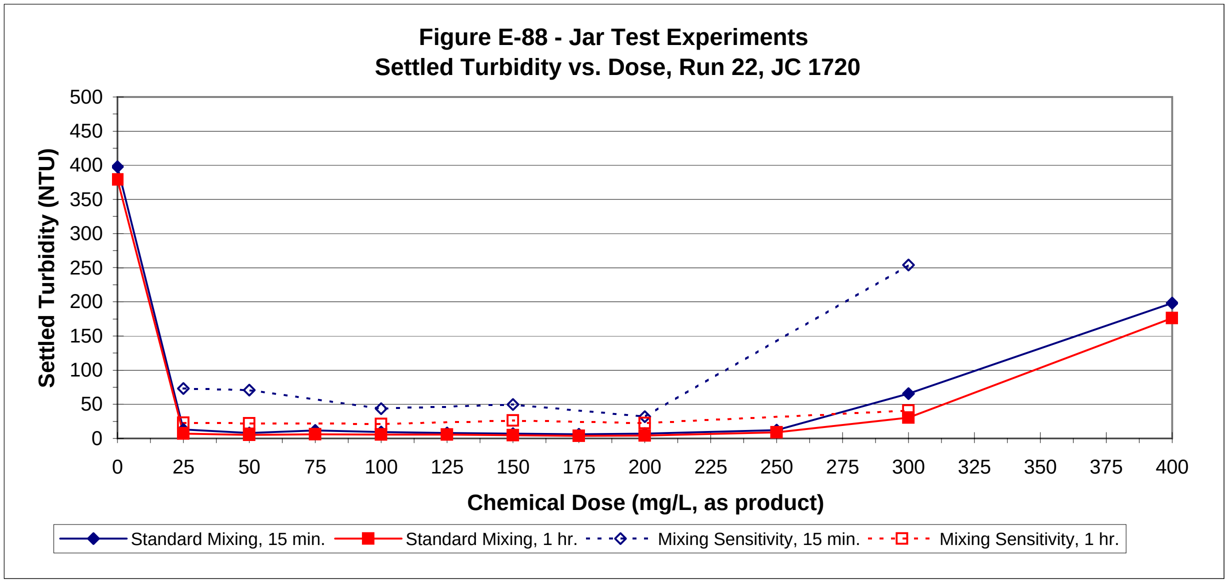


Figure E-88 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 22, JC 1720
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

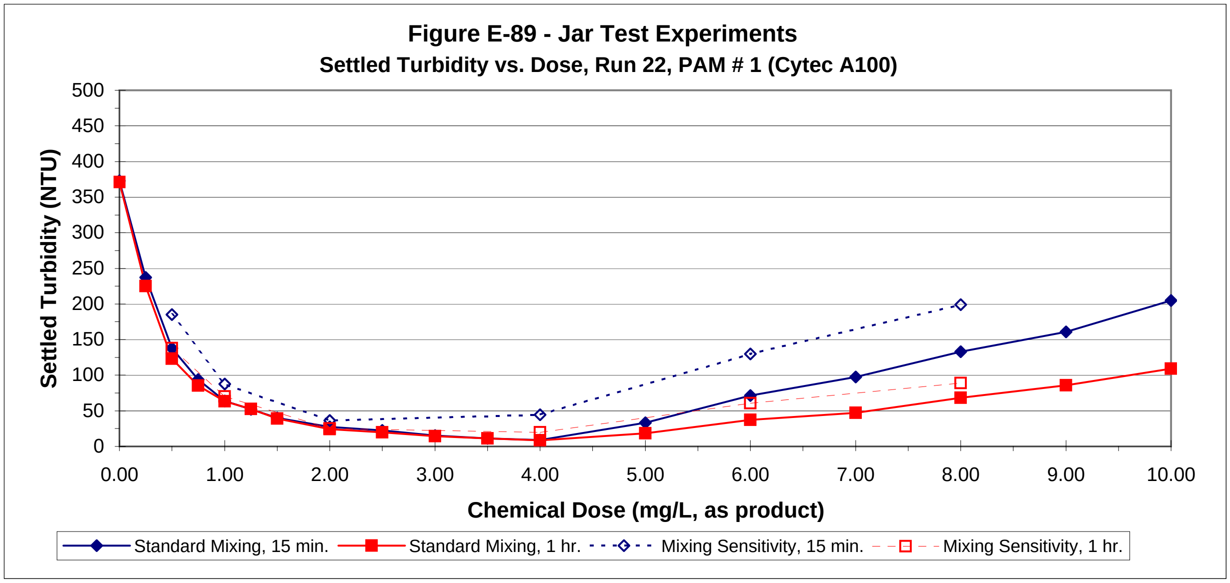


Figure E-89 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 22, PAM # 1 (Cytec A100)
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

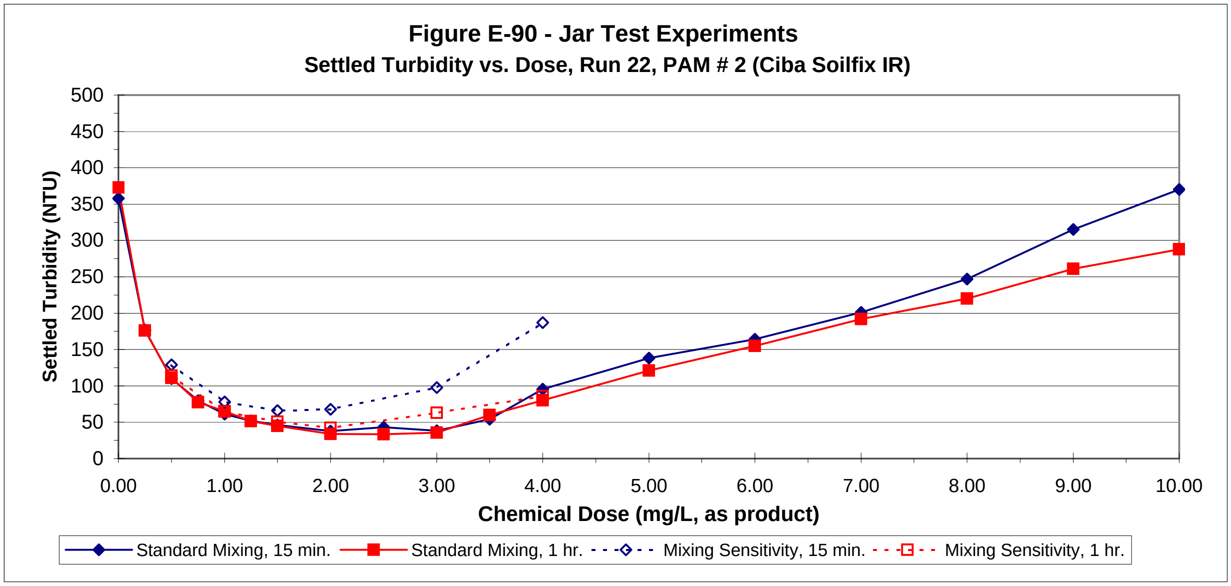


Figure E-90 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 22, PAM # 2 (Ciba Soilfix IR)
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

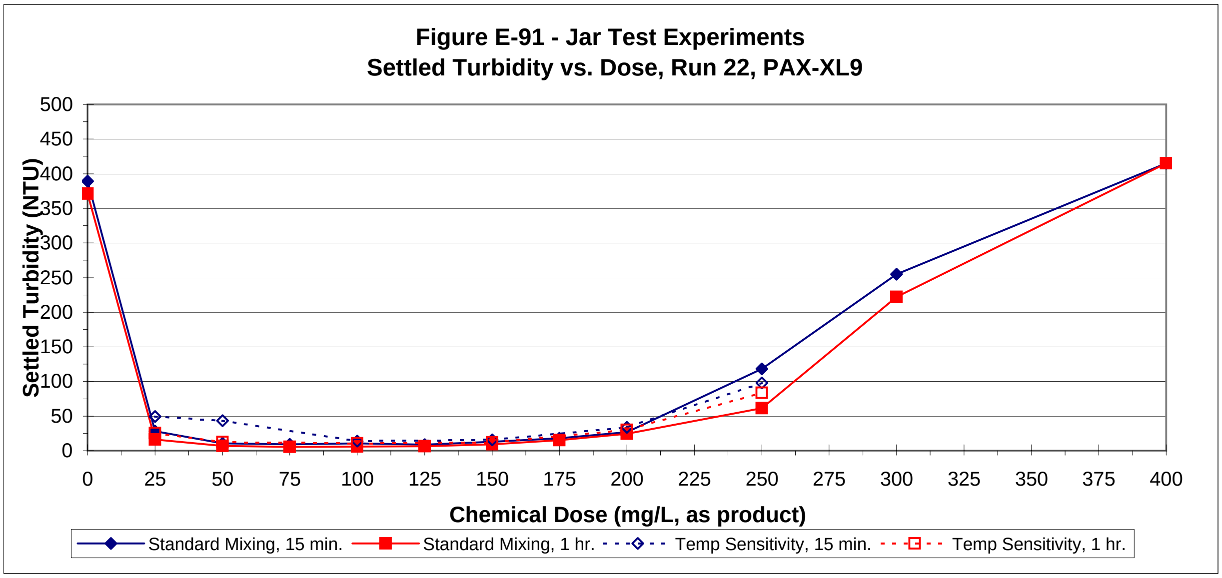


Figure E-91 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 22, PAX-XL9
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Temp Sensitivity, 15 min.
Temp Sensitivity, 1 hr.

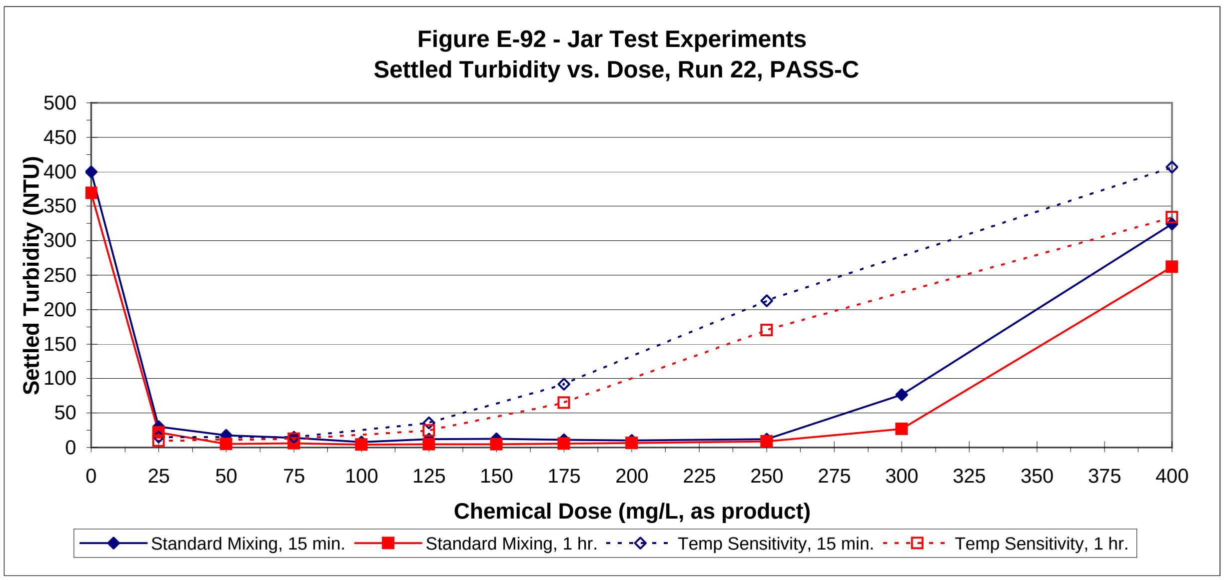


Figure E-92 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 22, PASS-C
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Temp Sensitivity, 15 min.
Temp Sensitivity, 1 hr.

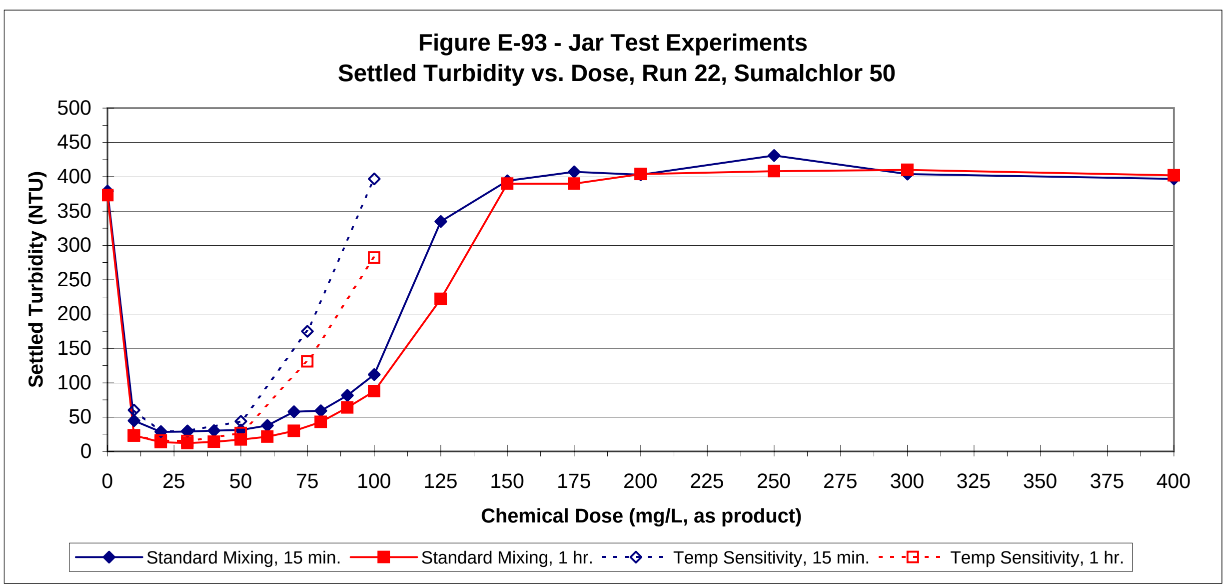


Figure E-93 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 22, Sumalchlor 50
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Temp Sensitivity, 15 min.
Temp Sensitivity, 1 hr.

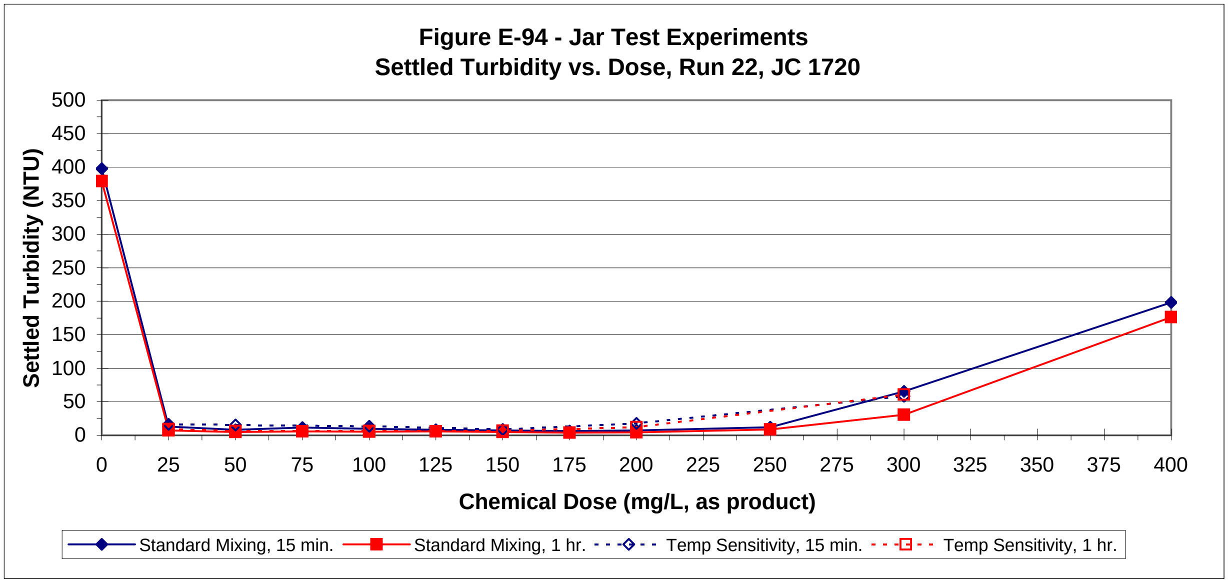


Figure E-94 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 22, JC 1720
Settled Turbidity (NTU)
500
450
400
350
300
250
200
150
100
50
0
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
375
400
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Temp Sensitivity, 15 min.
Temp Sensitivity, 1 hr.

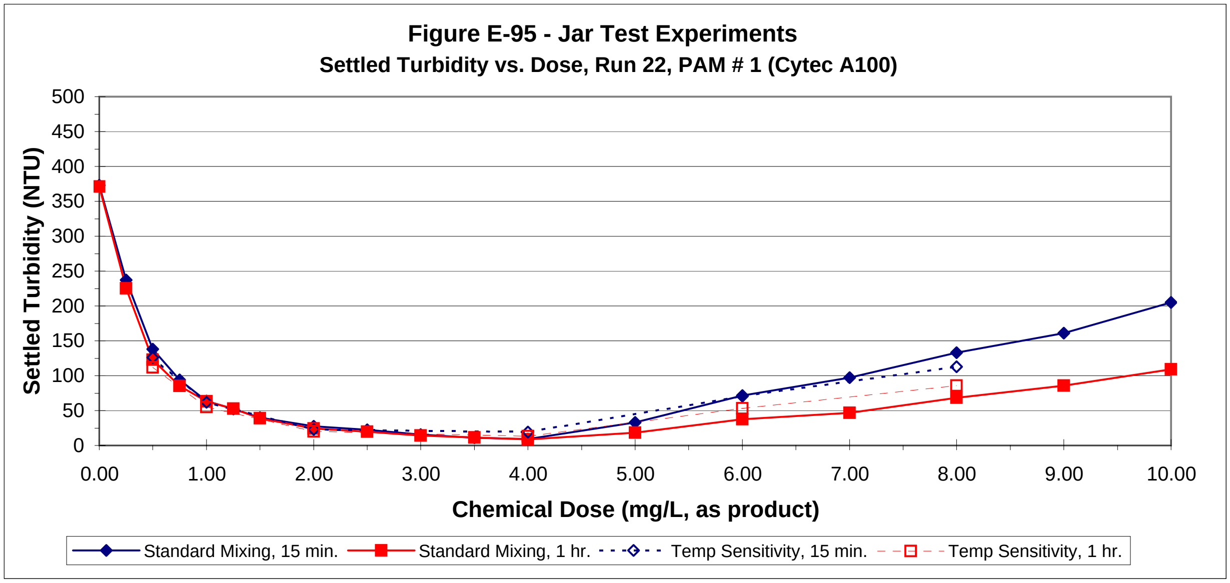


Figure E-95 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 22, PAM # 1 (Cytec A100)
Settled Turbidity (NTU)
500
450
400
350
300
250
200
150
100
50
0
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Temp Sensitivity, 15 min.
Temp Sensitivity, 1 hr.

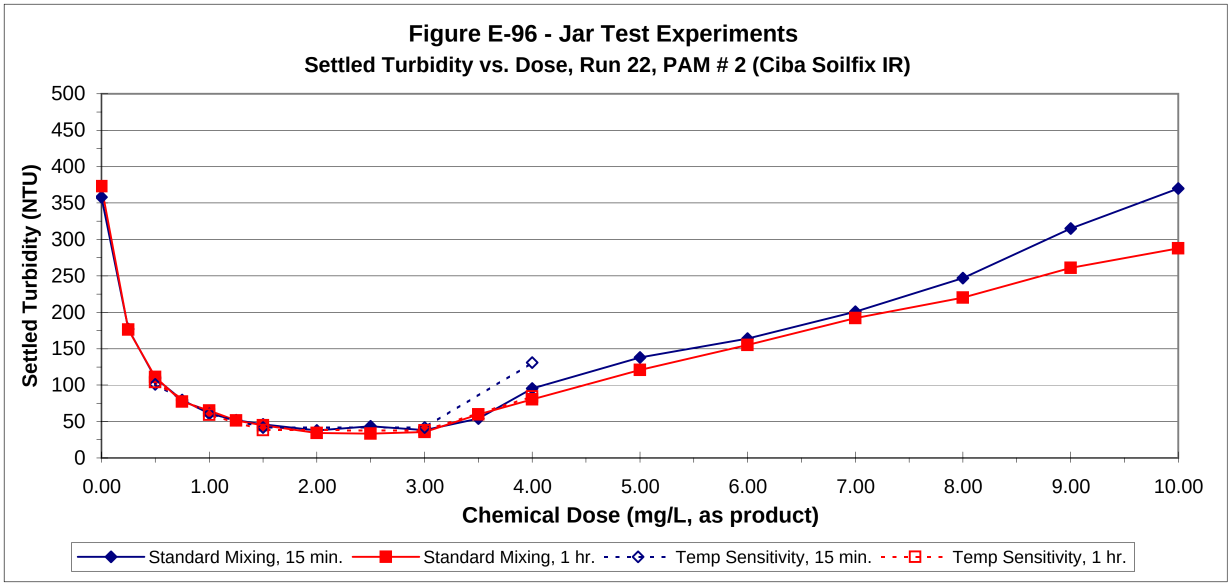


Figure E-96 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 22, PAM # 2 (Ciba Soilfix IR)
Settled Turbidity (NTU)
500
450
400
350
300
250
200
150
100
50
0
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Temp Sensitivity, 15 min.
Temp Sensitivity, 1 hr.

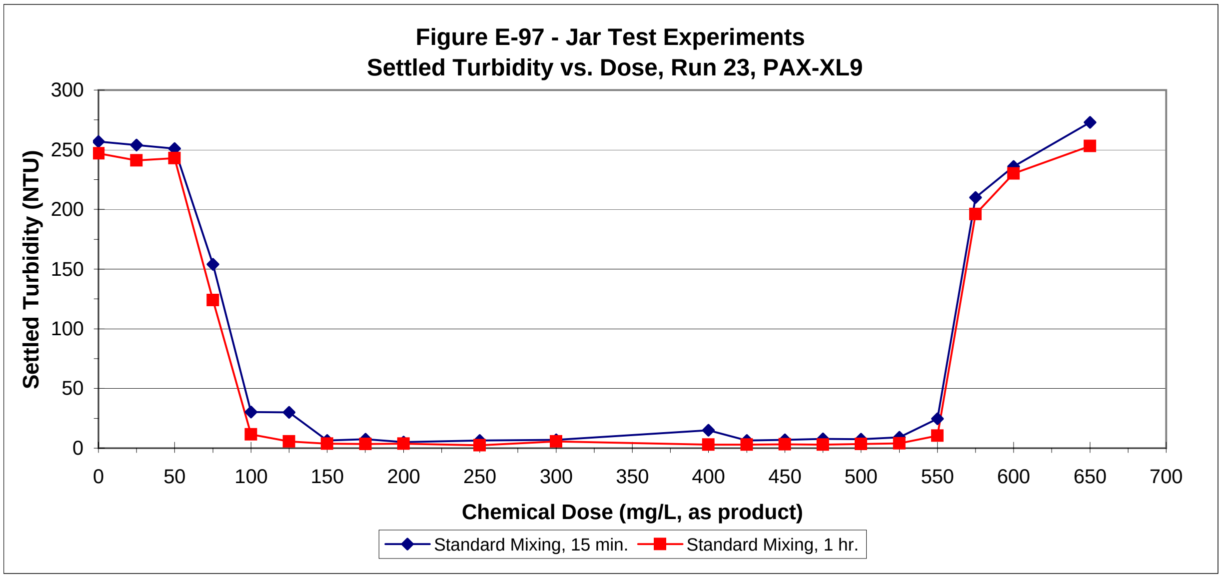


Figure E-97 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 23, PAX-XL9
Settled Turbidity (NTU)
300
250
200
150
100
50
0
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

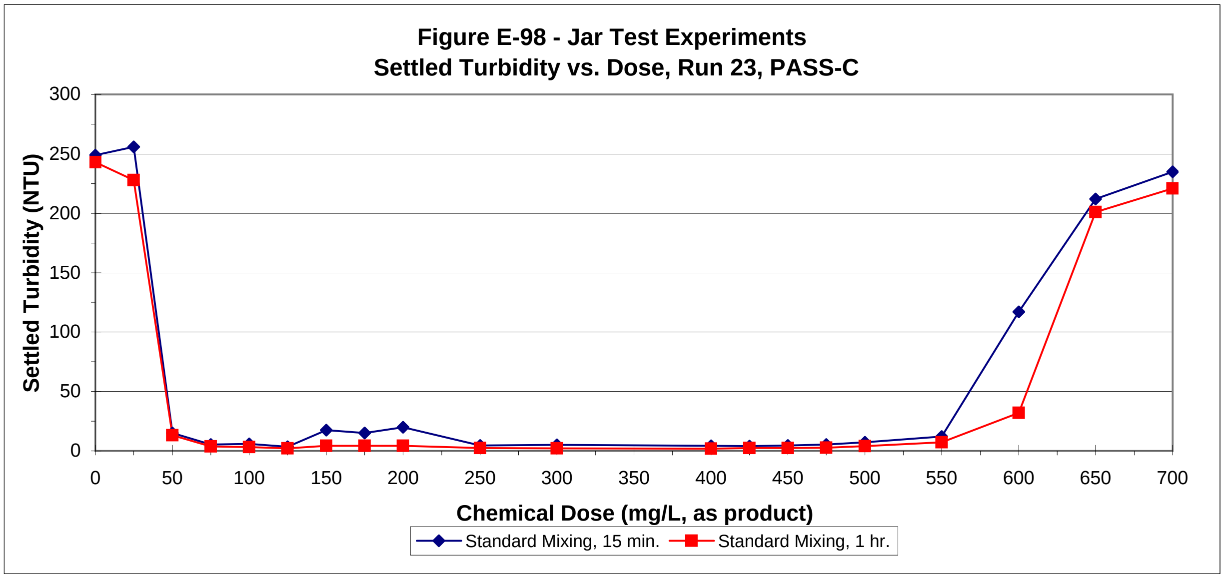


Figure E-98 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 23, PASS-C
Settled Turbidity (NTU)
300
250
200
150
100
50
0
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

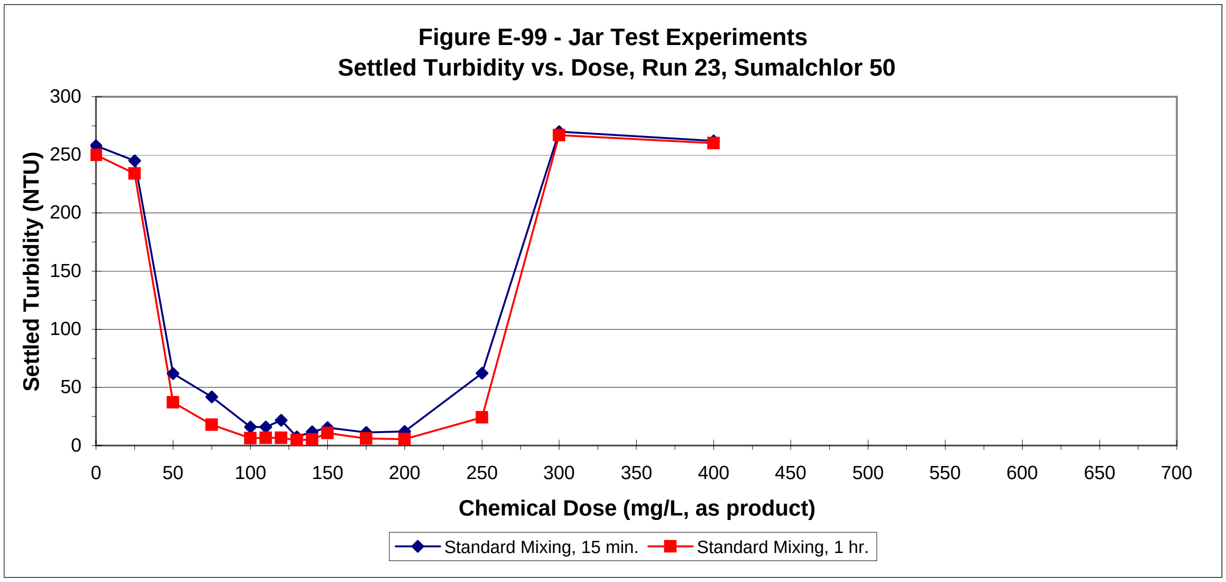


Figure E-99 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 23, Sumalchlor 50
Settled Turbidity (NTU)
300
250
200
150
100
50
0
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

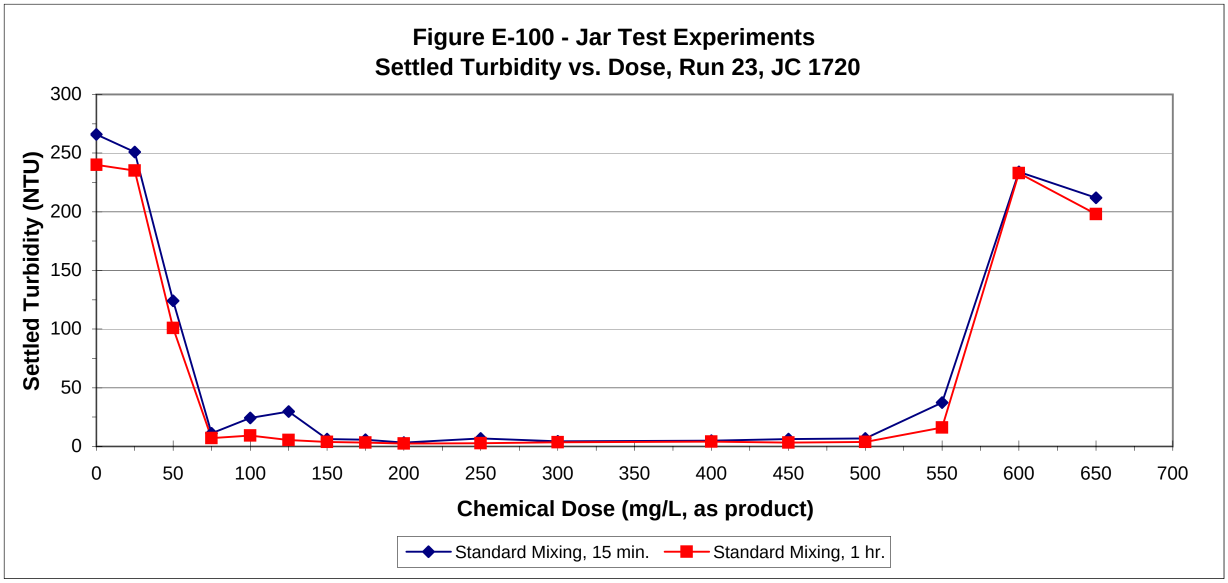


Figure E-100 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 23, JC 1720
Settled Turbidity (NTU)
0
50
100
150
200
250
300
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

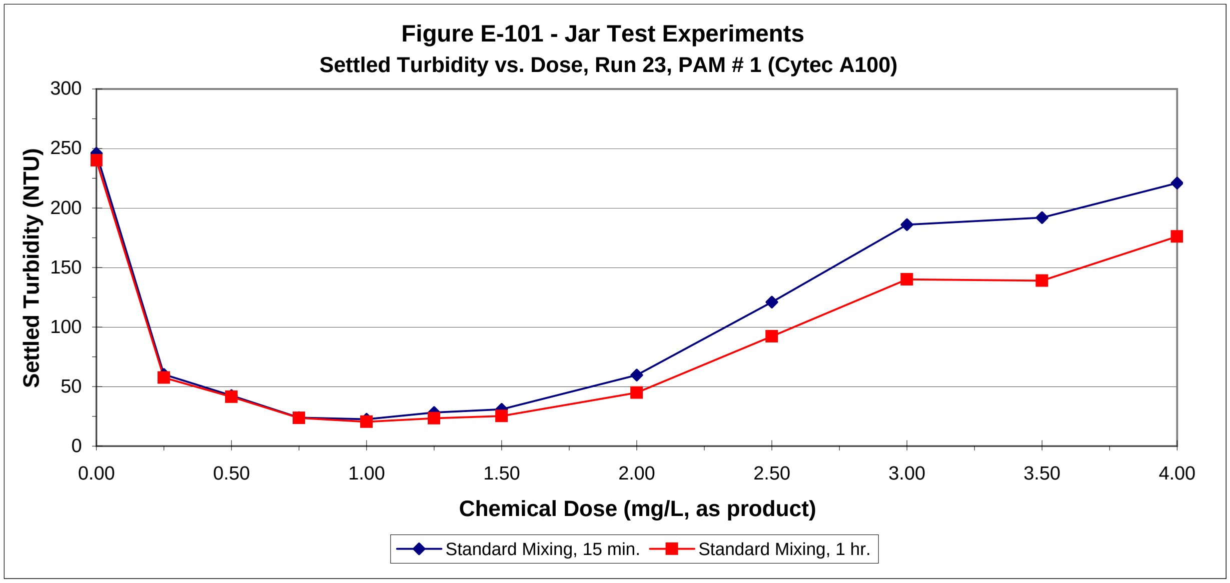


Figure E-101 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 23, PAM # 1 (Cytec A100)
Settled Turbidity (NTU)
0
50
100
150
200
250
300
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

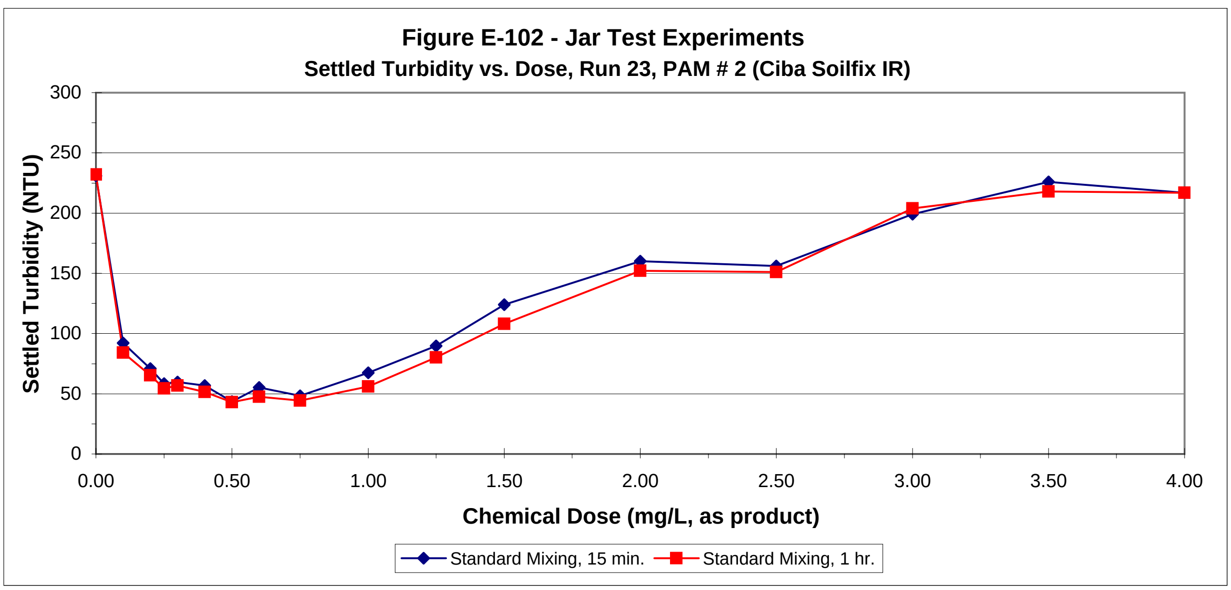


Figure E-102 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 23, PAM # 2 (Ciba Soilfix IR)
Settled Turbidity (NTU)
0
50
100
150
200
250
300
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.

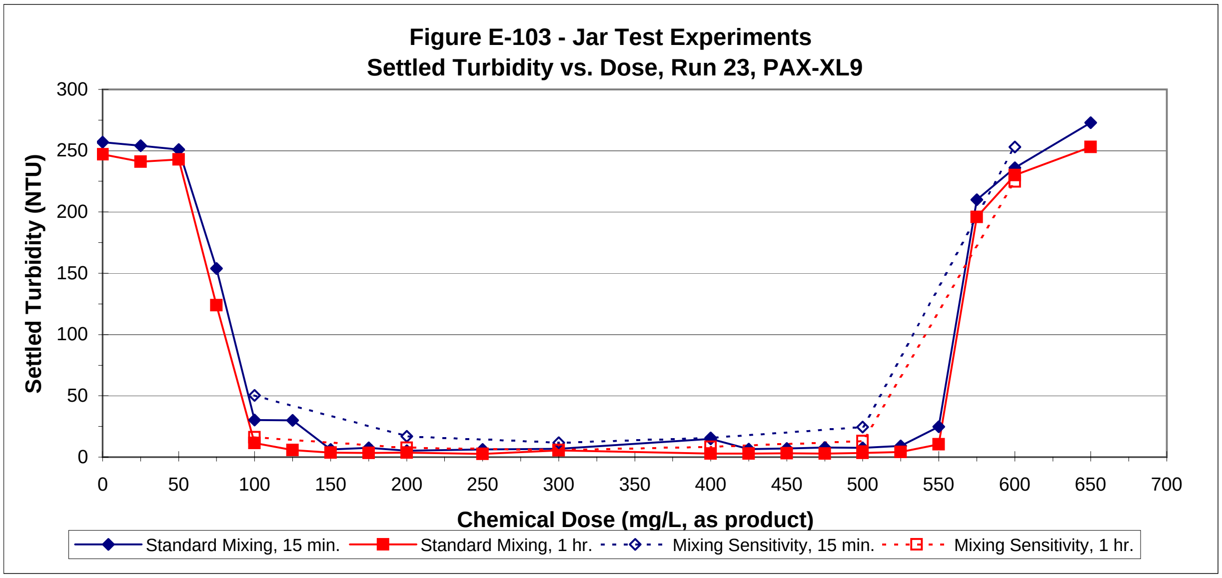


Figure E-103 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 23, PAX-XL9
Settled Turbidity (NTU)
300
250
200
150
100
50
0
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

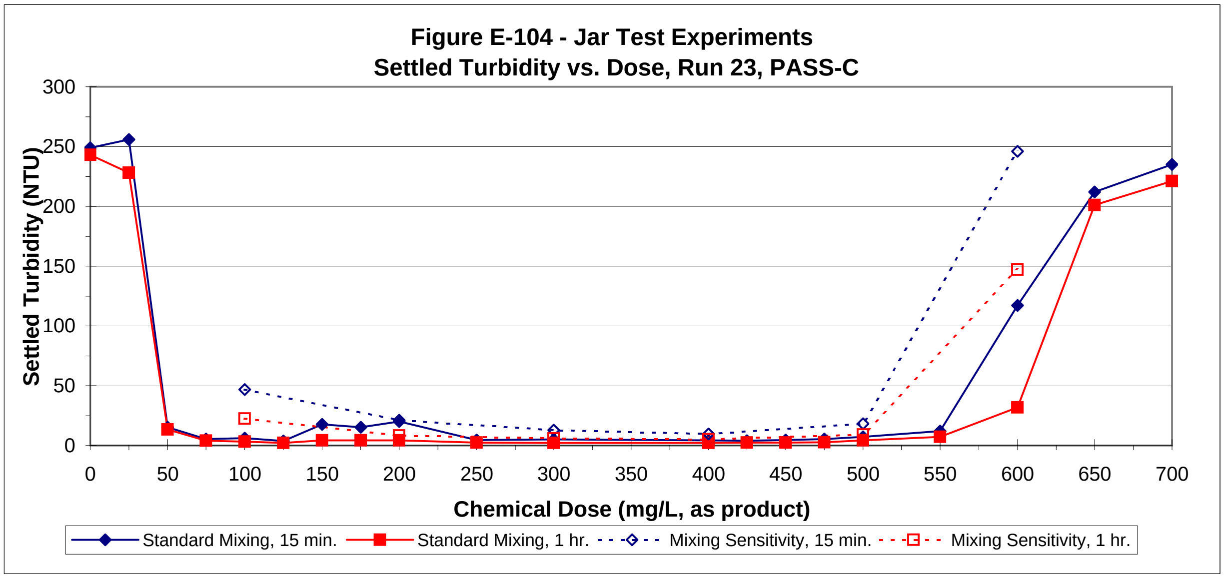


Figure E-104 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 23, PASS-C
Settled Turbidity (NTU)
300
250
200
150
100
50
0
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

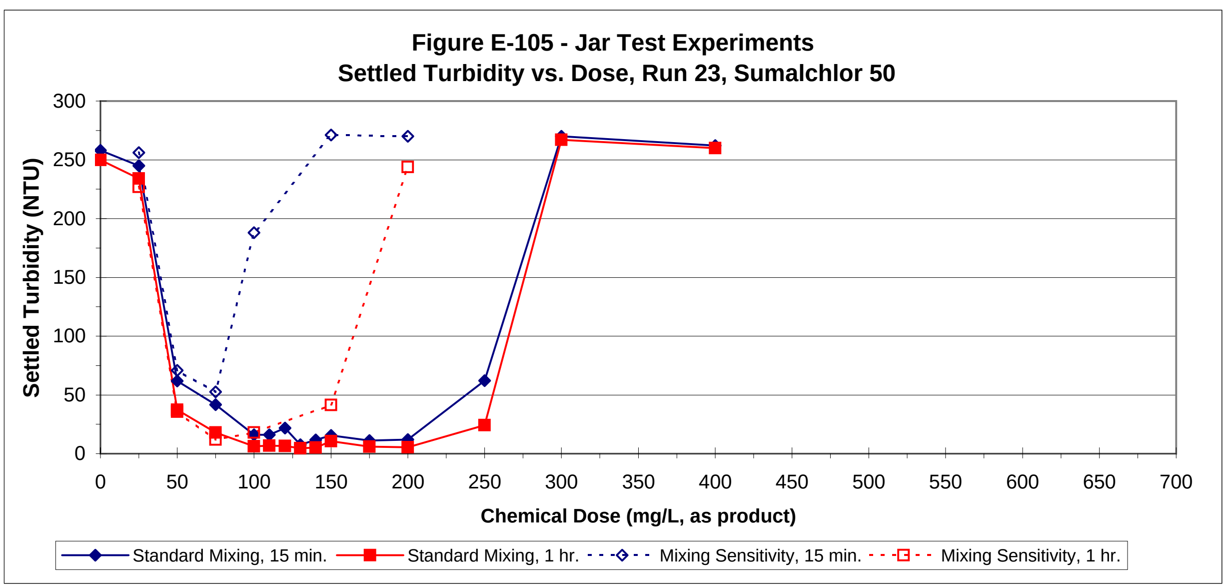


Figure E-105 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 23, Sumalchlor 50
Settled Turbidity (NTU)
300
250
200
150
100
50
0
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

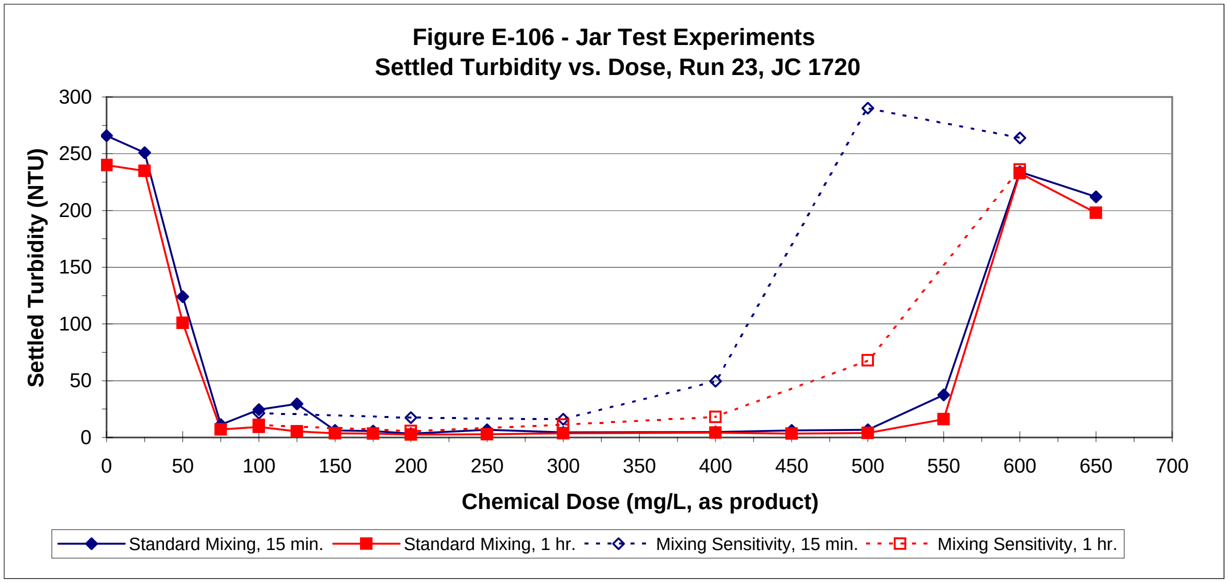


Figure E-106 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 23, JC 1720
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

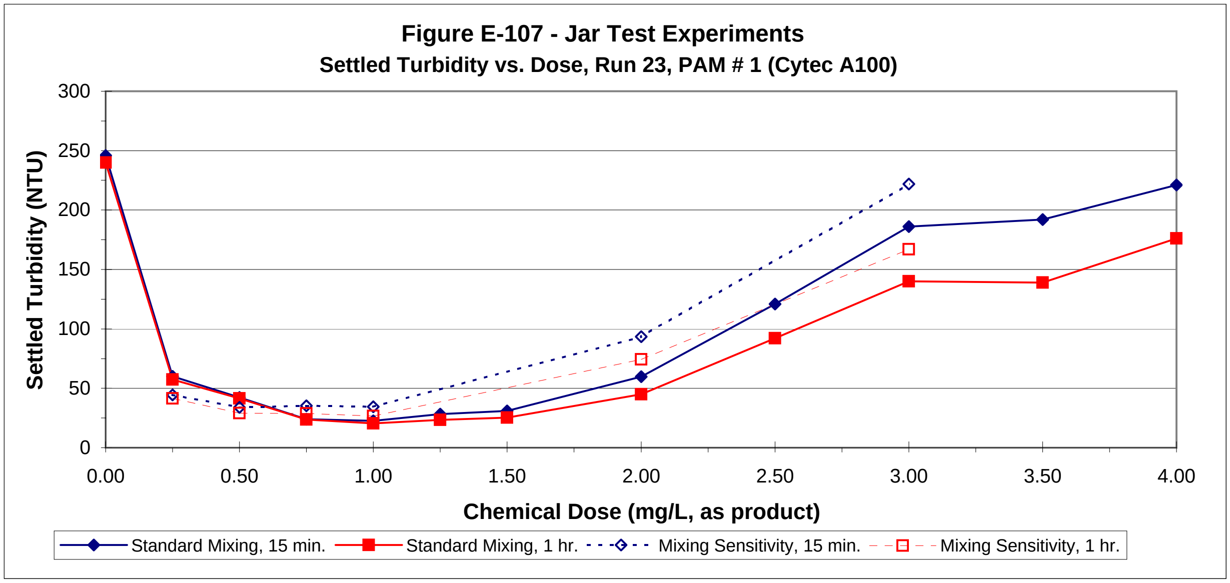


Figure E-107 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 23, PAM # 1 (Cytec A100)
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

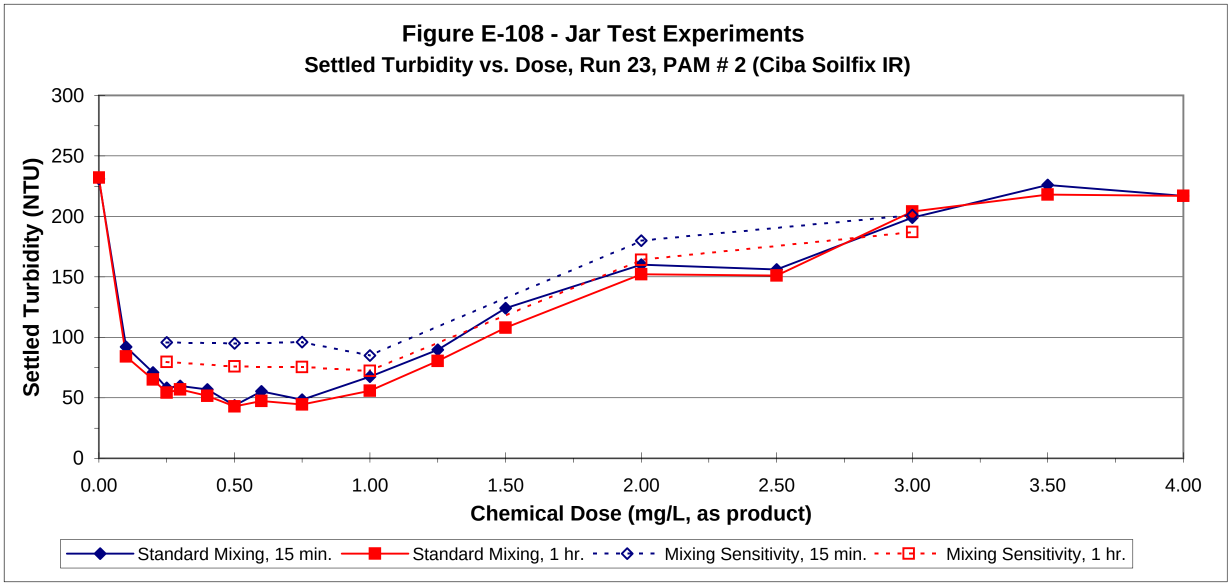


Figure E-108 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 23, PAM # 2 (Ciba Soilfix IR)
Settled Turbidity (NTU)
Chemical Dose (mg/L, as product)
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Mixing Sensitivity, 15 min.
Mixing Sensitivity, 1 hr.

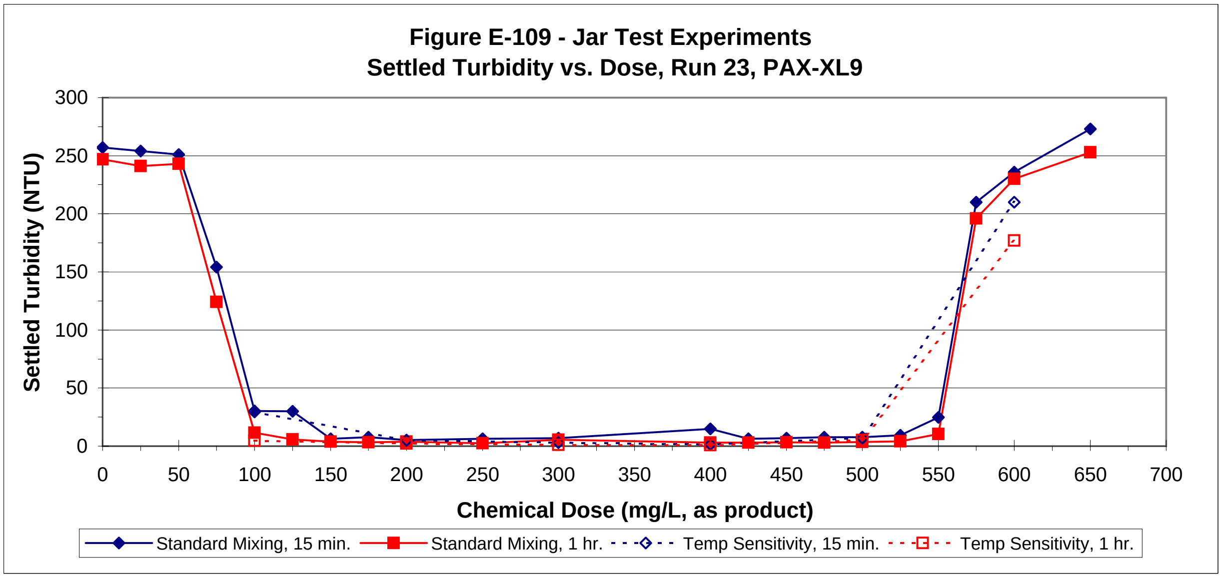


Figure E-109 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 23, PAX-XL9
Settled Turbidity (NTU)
0
50
100
150
200
250
300
Chemical Dose (mg/L, as product)
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Temp Sensitivity, 15 min.
Temp Sensitivity, 1 hr.

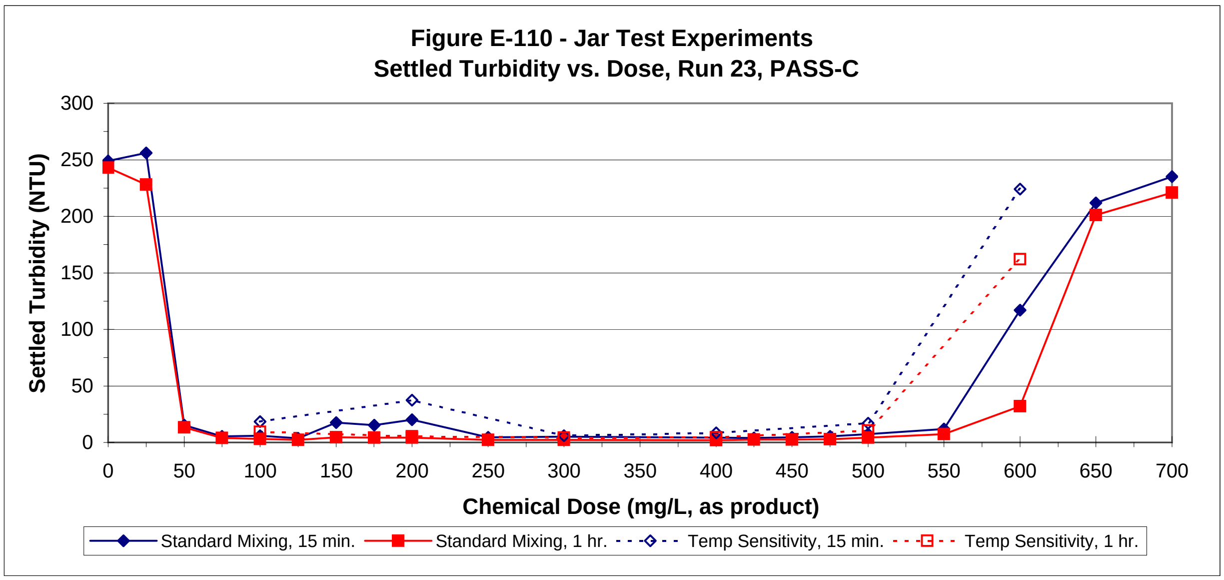


Figure E-110 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 23, PASS-C
Settled Turbidity (NTU)
0
50
100
150
200
250
300
Chemical Dose (mg/L, as product)
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Temp Sensitivity, 15 min.
Temp Sensitivity, 1 hr.

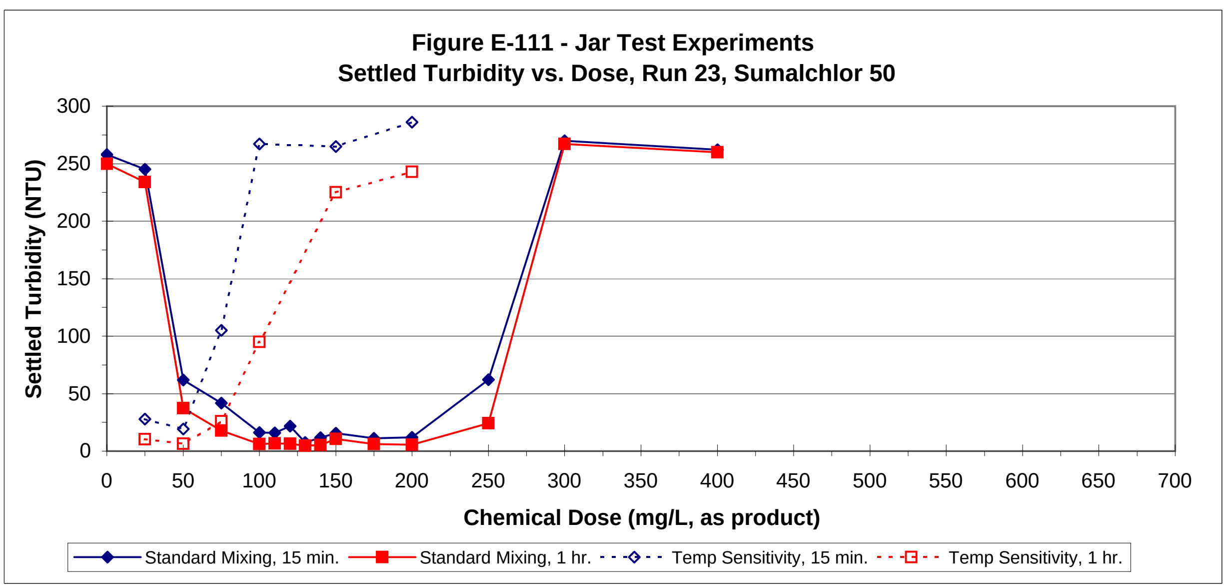


Figure E-111 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 23, Sumalchlor 50
Settled Turbidity (NTU)
0
50
100
150
200
250
300
Chemical Dose (mg/L, as product)
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
Standard Mixing, 15 min.
Standard Mixing, 1 hr.
Temp Sensitivity, 15 min.
Temp Sensitivity, 1 hr.

Figure E-112 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 23, JC 1720

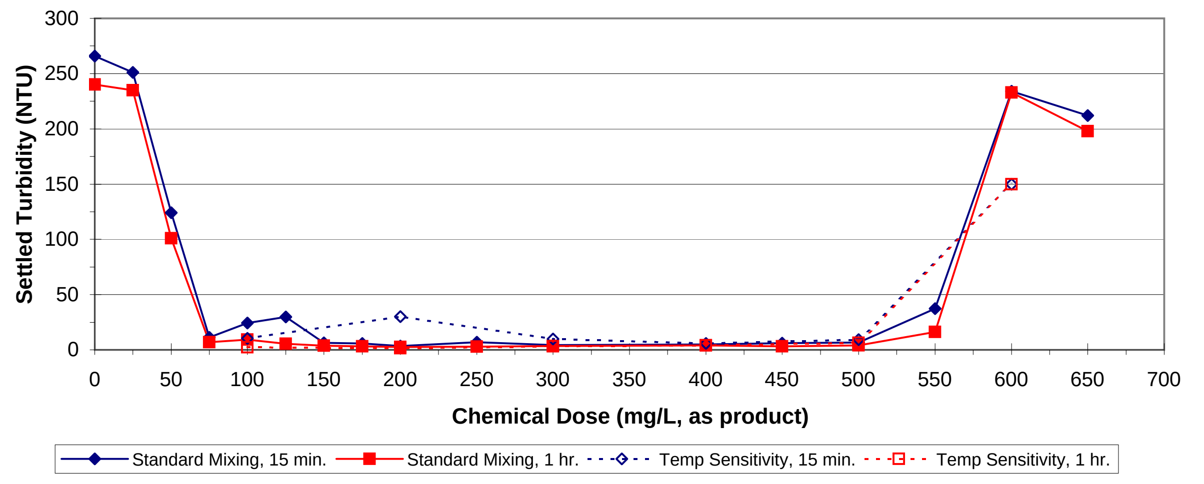


Figure E-113 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 23, PAM # 1 (Cytec A100)

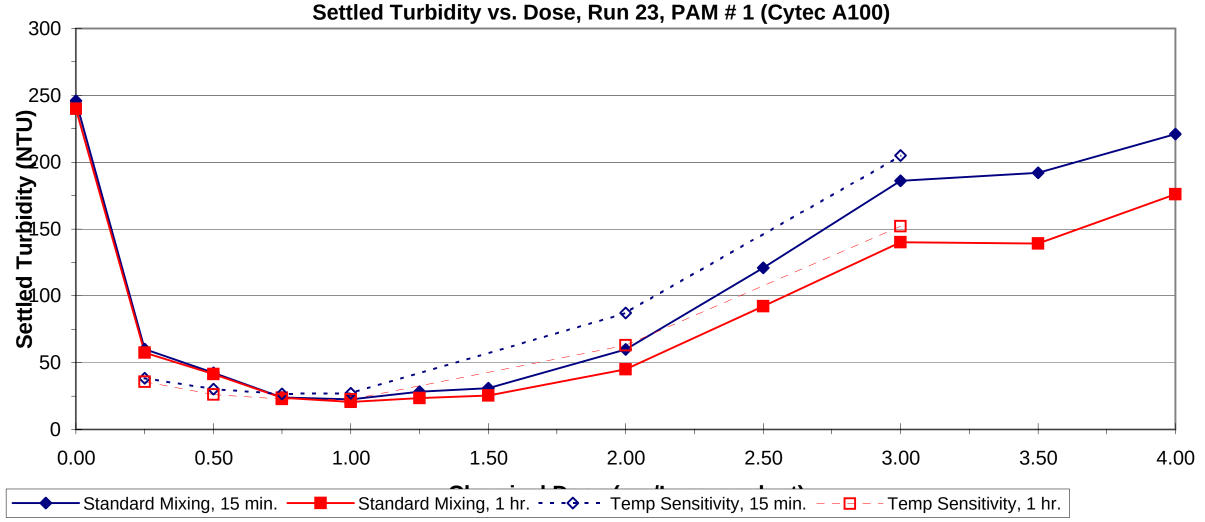
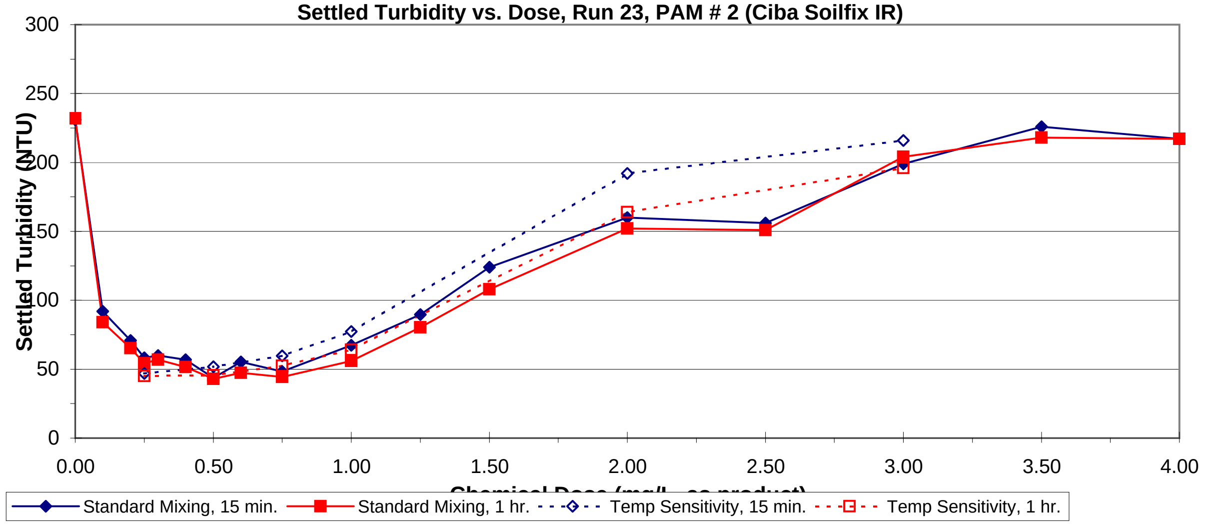


Figure E-114 - Jar Test Experiments
Settled Turbidity vs. Dose, Run 23, PAM # 2 (Ciba Soilfix IR)



Appendix F

Chemically Enhanced Sedimentation Experiments - Data

Table F-1, Phase IV Settling Experiments, Run 17A Data

Chemical =	**PAX-XL9**	
Date Run =	11/15/2004	
Water Source =	On-site Basin	
T=0 Temp (C) =	6.5	
T=8 Temp (C) =	7.8	
pH =	6.9	
EC (uS) =	4,732	
Target Dose (mg/L) =	70	
Actual Dose (mg/L) =	70	
	Turbidity (NTU)	
Time (hr)	Port A	Port D
0.00	153	162
0.25	81.0	91.0
0.50	63.3	67.4
1.00	50.9	55.7
8.00	10.6	12.1
24.00	3.8	5.0

			Est Time (hr) Turb = 20 NTU	
Time	Port A	Port D	Port A	Port D
1.0	50.9	55.7	6.37	6.73
8.0	10.6	12.1		

Chemical =	**JC 1720**	
Date Run =	11/15/2004	
Water Source =	On-site Basin	
T=0 Temp (C) =	6.5	
T=8 Temp (C) =	7.8	
pH =	6.8	
EC (uS) =	4,755	
Target Dose (mg/L) =	120	
Actual Dose (mg/L) =	110	
	Turbidity (NTU)	
Time (hr)	Port A	Port D
0.00	157	166
0.25	73.2	74.2
0.50	65.4	66.5
1.00	58.1	60.8
8.00	8.7	10.1
24.00	3.6	4.3

			Est Time (hr) Turb = 20 NTU	
Time	Port A	Port D	Port A	Port D
1.0	58.1	60.8	6.40	6.63
8.0	8.7	10.1		

Chemical =	**PAM #1 (Cytec A100)**	
Date Run =	11/15/2004	
Water Source =	On-site Basin	
T=0 Temp (C) =	6.5	
T=8 Temp (C) =	7.7	
pH =	7.1	
EC (uS) =	4,828	
Target Dose (mg/L) =	1.2	
Actual Dose (mg/L) =	1.2	
	Turbidity (NTU)	
Time (hr)	Port A	Port D
0.00	157	153
0.25	133	140
0.50	107	112
1.00	79.9	90.9
8.00	49.8	54.9
24.00	29.4	35.4

			Est Time (hr) Turb = 20 NTU	
Time	Port A	Port D	Port A	Port D
8.0	49.8	54.9	31.37	36.64
24.0	29.4	35.4		

Chemical =	**No-Chem Control**	
Date Run =	11/15/2004	
Water Source =	On-site Basin	
T=0 Temp (C) =	6.5	
T=8 Temp (C) =	7.7	
pH =	7.2	
EC (uS) =	4,844	
Target Dose (mg/L) =	N/A	
Actual Dose (mg/L) =	N/A	
	Turbidity (NTU)	
Time (hr)	Port A	Port D
0.00	158	156
0.25	158	158
0.50	159	157
1.00	157	161
8.00	156	158
24.00	128	148

			Est Time (hr) Turb = 20 NTU	
Time	Port A	Port D	Port A	Port D
8.0	156	158.0	85.71	228.80
24.0	128	148.0		

Run 17A, 11/12/04 (on-site basin)

Table F-2, Phase IV Settling Experiments, Run 18 Data

Chemical =	**PAX-XL9**	
Date Run =	12/12/2004	(Run 18)
Water Source =	HY89+Ski Run	
T=0 Temp (C) =	7.3	
T=8 Temp (C) =	9.4	
pH =	6.7	
EC (uS) =	2,072	
Target Dose (mg/L) =	100	
Actual Dose (mg/L) =	100	
	Turbidity (NTU)	
Time (hr)	Port A	Port D
0.00	182	186
0.25	67.6	69.3
0.50	52.5	57.5
1.00	43.3	47.4
8.00	9.2	11.5
24.00	2.7	4.5

			Est Time (hr) Turb = 20 NTU	
Time	Port A	Port D	Port A	Port D
1.0	43.3	47.4	5.78	6.34
8.0	9.2	11.5		

Chemical =	**JC 1720**	
Date Run =	12/12/2004	(Run 18)
Water Source =	HY89+Ski Run	
T=0 Temp (C) =	7.2	
T=8 Temp (C) =	9.8	
pH =	6.8	
EC (uS) =	2,040	
Target Dose (mg/L) =	80	
Actual Dose (mg/L) =	80	
	Turbidity (NTU)	
Time (hr)	Port A	Port D
0.00	180	183
0.25	75.2	89.2
0.50	64.7	68.2
1.00	53.3	58.4
8.00	7.9	12.3
24.00	3.1	3.9

			Est Time (hr) Turb = 20 NTU	
Time	Port A	Port D	Port A	Port D
1.0	53.3	58.4	6.13	6.83
8.0	7.9	12.3		

Chemical =	**PAM #1 (Cytec A100)**	
Date Run =	12/12/2004	(Run 18)
Water Source =	HY89+Ski Run	
T=0 Temp (C) =	7.2	
T=8 Temp (C) =	8.9	
pH =	7.1	
EC (uS) =	2,037	
Target Dose (mg/L) =	0.50	
Actual Dose (mg/L) =	0.52	
	Turbidity (NTU)	
Time (hr)	Port A	Port D
0.00	174	178
0.25	147	156
0.50	143	147
1.00	138	143
8.00	96.2	106
24.00	54.3	67.3

			Est Time (hr) Turb = 20 NTU	
Time	Port A	Port D	Port A	Port D
8.0	96.2	106.0	37.10	43.56
24.0	54.3	67.3		

Chemical =	**No-Chem Control**	
Date Run =	12/12/2004	(Run 18)
Water Source =	HY89+Ski Run	
T=0 Temp (C) =	7.2	
T=8 Temp (C) =	9.4	
pH =	7.1	
EC (uS) =	2,050	
Target Dose (mg/L) =	N/A	
Actual Dose (mg/L) =	N/A	
	Turbidity (NTU)	
Time (hr)	Port A	Port D
0.00	187	194
0.25	191	194
0.50	189	190
1.00	194	191
8.00	158	164
24.00	98	122

			Est Time (hr) Turb = 20 NTU	
Time	Port A	Port D	Port A	Port D
8.0	158	164.0	44.80	62.86
24.0	98	122.0		

Table F-3, Phase IV Settling Experiments, Run 19 Data

Chemical =	**PAX-XL9**	
Date Run =	12/19/2004	(Run 19)
Water Source =	On-Site Basin	
T=0 Temp (C) =	9.6	
T=8 Temp (C) =	10.8	
pH =	6.6	
EC (uS) =	1,930	
Target Dose (mg/L) =	100	
Actual Dose (mg/L) =	105	

	Turbidity (NTU)	
Time (hr)	Port A	Port D
0.00	698	738
0.25	122.0	123.0
0.50	102.0	111.0
1.00	101.0	97.5
8.00	13.7	33.3
24.00	4.8	5.6

			Est Time (hr) Turb = 20 NTU	
Time	Port A	Port D	Port A	Port D
1.0	101.0	97.5	7.49	9.45
8.0	13.7	33.3		

Chemical =	**JC 1720**	
Date Run =	12/19/2004	(Run 19)
Water Source =	On-Site Basin	
T=0 Temp (C) =	9.5	
T=8 Temp (C) =	10.4	
pH =	7.0	
EC (uS) =	1,864	
Target Dose (mg/L) =	30	
Actual Dose (mg/L) =	32	

	Turbidity (NTU)	
Time (hr)	Port A	Port D
0.00	524	703
0.25	96.9	85.5
0.50	73.6	76.2
1.00	64.5	64.8
8.00	12.7	14.3
24.00	4.6	5.5

			Est Time (hr) Turb = 20 NTU	
Time	Port A	Port D	Port A	Port D
1.0	64.5	64.8	7.01	7.21
8.0	12.7	14.3		

Chemical =	**PAM #1 (Cytec A100)**	
Date Run =	12/19/2004	(Run 19)
Water Source =	On-Site Basin	
T=0 Temp (C) =	9.5	
T=8 Temp (C) =	10.9	
pH =	7.2	
EC (uS) =	1,849	
Target Dose (mg/L) =	2.75	
Actual Dose (mg/L) =	2.74	

	Turbidity (NTU)	
Time (hr)	Port A	Port D
0.00	287	852
0.25	240	260
0.50	235	232
1.00	212	221
8.00	145	154
24.00	110	125

			Est Time (hr) Turb = 20 NTU	
Time	Port A	Port D	Port A	Port D
8.0	145	154	65.14	81.93
24.0	110	125		

Chemical =	**No-Chem Control**	
Date Run =	12/19/2004	(Run 19)
Water Source =	On-Site Basin	
T=0 Temp (C) =	9.4	
T=8 Temp (C) =	11.3	
pH =	7.3	
EC (uS) =	1,860	
Target Dose (mg/L) =	N/A	
Actual Dose (mg/L) =	N/A	

	Turbidity (NTU)	
Time (hr)	Port A	Port D
0.00	838	840
0.25	819	832
0.50	802	834
1.00	796	810
8.00	728	771
24.00	603	684

			Est Time (hr) Turb = 20 NTU	
Time	Port A	Port D	Port A	Port D
8.0	728	771	98.62	146.11
24.0	603	684		

Table F-4, Phase IV Settling Experiments, Run 20 Data

Chemical =	**PAX-XL9**	
Date Run =	3/14/2005	(Run 20)
Water Source =	On-Site Basin	
T=0 Temp (C) =	5.6	
T=8 Temp (C) =	7.6	
pH =	6.3	
EC (uS) =	2,944	
Target Dose (mg/L) =	290	
Actual Dose (mg/L) =	290	
	Turbidity (NTU)	
Time (hr)	Port A	Port D
0.00	1765	1765
0.0001	1557	1528
0.25	44.7	46.2
0.50	36.6	43.5
1.00	34.5	36.3
8.00	9.2	11.0
24.00	4.0	4.3

			Est Time (hr) Turb = 20 NTU	
Time	Port A	Port D	Port A	Port D
1.0	34.5	36.3	5.01	5.51
8.0	9.2	11.0		

Chemical =	**JC 1720**	
Date Run =	3/14/2005	(Run 20)
Water Source =	On-Site Basin	
T=0 Temp (C) =	5.5	
T=8 Temp (C) =	7.6	
pH =	6.4	
EC (uS) =	2,958	
Target Dose (mg/L) =	240	
Actual Dose (mg/L) =	240	
	Turbidity (NTU)	
Time (hr)	Port A	Port D
0.00	1765	1765
0.0001	1560	1570
0.25	43.8	47.5
0.50	42.5	42.7
1.00	39.6	40.1
8.00	8.2	9.7
24.00	3.5	3.9

			Est Time (hr) Turb = 20 NTU	
Time	Port A	Port D	Port A	Port D
1.0	39.6	40.1	5.37	5.63
8.0	8.2	9.7		

Chemical =	**PAM #1 (Cytec A100)**	
Date Run =	3/14/2005	(Run 20)
Water Source =	On-Site Basin	
T=0 Temp (C) =	5.6	
T=8 Temp (C) =	7.7	
pH =	7.2	
EC (uS) =	2,842	
Target Dose (mg/L) =	10.00	
Actual Dose (mg/L) =	9.82	
	Turbidity (NTU)	
Time (hr)	Port A	Port D
0.00	1765	1765
0.0001	184	274
0.25	63.5	70.6
0.50	49.3	50.2
1.00	43.7	43.2
8.00	27.8	27.9
24.00	22.7	24.9

			Est Time (hr) Turb = 20 NTU	
Time	Port A	Port D	Port A	Port D
8.0	27.8	27.9	32.47	50.13
24.0	22.7	24.9		

Chemical =	**No-Chem Control**	
Date Run =	3/14/2005	(Run 20)
Water Source =	On-Site Basin	
T=0 Temp (C) =	5.7	
T=8 Temp (C) =	7.6	
pH =	7.2	
EC (uS) =	2,858	
Target Dose (mg/L) =	N/A	
Actual Dose (mg/L) =	N/A	
	Turbidity (NTU)	
Time (hr)	Port A	Port D
0.00	1765	1765
0.0001	1763	1761
0.25	1744	1770
0.50	1714	1785
1.00	1731	1775
8.00	699	1389
24.00	247	338

			Est Time (hr) Turb = 20 NTU	
Time	Port A	Port D	Port A	Port D
8.0	699	1389	32.04	28.84
24.0	247	338		

Table F-5, Phase IV Settling Experiments, Run 21 Data

Chemical =	**PAX-XL9**	
Date Run =	3/24/2005	(Run 21)
Water Source =	HY89+Al Tahoe + Ski Run	
T=0 Temp (C) =	7.3	
T=8 Temp (C) =	8.6	
pH =	6.9	
EC (uS) =	661	
Target Dose (mg/L) =	90	
Actual Dose (mg/L) =	92	

	Turbidity (NTU)	
Time (hr)	Port A	Port D
0.00	257	257
0.0001	248	248
0.25	57.3	58.0
0.50	47.7	48.6
1.00	39.8	41.7
8.00	5.3	7.1
24.00	2.4	2.7

			Est Time (hr) Turb = 20 NTU	
Time	Port A	Port D	Port A	Port D
1.0	39.8	41.7	5.01	5.38
8.0	5.3	7.1		

Chemical =	**JC 1720**	
Date Run =	3/24/2005	(Run 21)
Water Source =	HY89+Al Tahoe + Ski Run	
T=0 Temp (C) =	7.3	
T=8 Temp (C) =	8.0	
pH =	6.9	
EC (uS) =	656	
Target Dose (mg/L) =	100	
Actual Dose (mg/L) =	100	

	Turbidity (NTU)	
Time (hr)	Port A	Port D
0.00	257	257
0.0001	242	243
0.25	71.3	74.4
0.50	58.0	63.4
1.00	48.4	50.2
8.00	5.4	6.3
24.00	2.5	3.1

			Est Time (hr) Turb = 20 NTU	
Time	Port A	Port D	Port A	Port D
1.0	48.4	50.2	5.62	5.81
8.0	5.4	6.3		

Chemical =	**PAM #1 (Cytec A100)**	
Date Run =	3/24/2005	(Run 21)
Water Source =	HY89+Al Tahoe + Ski Run	
T=0 Temp (C) =	7.4	
T=8 Temp (C) =	8.4	
pH =	7.3	
EC (uS) =	641	
Target Dose (mg/L) =	0.35	
Actual Dose (mg/L) =	0.35	

	Turbidity (NTU)	
Time (hr)	Port A	Port D
0.00	257	257
0.0001	229	235
0.25	199	221
0.50	193	202
1.00	180	189
8.00	114	123
24.00	65.6	78.7

			Est Time (hr) Turb = 20 NTU	
Time	Port A	Port D	Port A	Port D
8.00	114	123	39.07	45.20
24.00	65.6	78.7		

Chemical =	**No-Chem Control**	
Date Run =	3/24/2005	(Run 21)
Water Source =	HY89+Al Tahoe + Ski Run	
T=0 Temp (C) =	7.2	
T=8 Temp (C) =	8.3	
pH =	7.4	
EC (uS) =	644	
Target Dose (mg/L) =	N/A	
Actual Dose (mg/L) =	N/A	

	Turbidity (NTU)	
Time (hr)	Port A	Port D
0.00	257	257
0.0001	256	258
0.25	256	255
0.50	244	253
1.00	248	252
8.00	210	232
24.00	118	165

			Est Time (hr) Turb = 20 NTU	
Time	Port A	Port D	Port A	Port D
8.0	210	232	41.04	58.63
24.0	118	165		

Table F-6, Phase IV Settling Experiments, Run 22 Data

Chemical =	**PAX-XL9**	
Date Run =	4/29/2005 (Run 22)	
Water Source =	Melt Water, On-Site Basin	
T=0 Temp (C) =	13.7	
T=8 Temp (C) =	14.0	
pH =	6.7	
EC (uS) =	3,623	
Target Dose (mg/L) =	125	
Actual Dose (mg/L) =	125	
	Turbidity (NTU)	
Time (hr)	Port A	Port D
0.00	400	400
0.0001	365	387
0.25	59.3	57.3
0.50	50.7	50.3
1.00	46.1	48.6
8.00	9.0	10.7
24.00	4.7	3.7

			Est Time (hr) Turb = 20 NTU	
Time	Port A	Port D	Port A	Port D
1.0	46.1	48.6	5.92	6.28
8.0	9.0	10.7		

Chemical =	**JC 1720**	
Date Run =	4/29/2005 (Run 22)	
Water Source =	Melt Water, On-Site Basin	
T=0 Temp (C) =	13.5	
T=8 Temp (C) =	14.0	
pH =	6.4	
EC (uS) =	3,509	
Target Dose (mg/L) =	175	
Actual Dose (mg/L) =	174	
	Turbidity (NTU)	
Time (hr)	Port A	Port D
0.00	400	400
0.0001	292	405
0.25	69.0	71.4
0.50	63.3	68.6
1.00	44.7	54.4
8.00	7.2	10.2
24.00	2.7	2.8

			Est Time (hr) Turb = 20 NTU	
Time	Port A	Port D	Port A	Port D
1.0	44.7	54.4	5.61	6.45
8.0	7.2	10.2		

Chemical =	**PAM #1 (Cytec A100)**	
Date Run =	4/29/2005 (Run 22)	
Water Source =	Melt Water, On-Site Basin	
T=0 Temp (C) =	14.3	
T=8 Temp (C) =	14.7	
pH =	7.2	
EC (uS) =	3,557	
Target Dose (mg/L) =	4.00	
Actual Dose (mg/L) =	3.96	
	Turbidity (NTU)	
Time (hr)	Port A	Port D
0.00	400	400
0.0001	158	175
0.25	114	128
0.50	96.1	107
1.00	79.5	85.8
8.00	40.0	45.1
24.00	34.0	34.0

			Est Time (hr) Turb = 20 NTU	
Time	Port A	Port D	Port A	Port D
8.0	40.0	45.1	61.33	44.18
24.0	34.0	34.0		

Chemical =	**No-Chem Control**	
Date Run =	4/29/2005 (Run 22)	
Water Source =	Melt Water, On-Site Basin	
T=0 Temp (C) =	14.2	
T=8 Temp (C) =	14.0	
pH =	7.2	
EC (uS) =	3,566	
Target Dose (mg/L) =	N/A	
Actual Dose (mg/L) =	N/A	
	Turbidity (NTU)	
Time (hr)	Port A	Port D
0.00	400	400
0.0001	381	397
0.25	401	400
0.50	390	400
1.00	390	395
8.00	352	376
24.00	196	198

			Est Time (hr) Turb = 20 NTU	
Time	Port A	Port D	Port A	Port D
8.0	352	376	42.05	40.00
24.0	196	198		

Table F-7, Phase IV Settling Experiments, Run 23 Data

Chemical =	**PAX-XL9**	
Date Run =	5/2/2005	(Run 23)
Water Source =	Rain Event, HY-89	
T=0 Temp (C) =	15.0	
T=8 Temp (C) =	14.5	
pH =	6.7	
EC (uS) =	699	
Target Dose (mg/L) =	250	
Actual Dose (mg/L) =	247	
	Turbidity (NTU)	
Time (hr)	Port A	Port D
0.00	310	310
0.0001	167	282
0.25	26.2	25.9
0.50	21.1	22.1
1.00	17.2	17.0
8.00	3.6	2.9
24.00	1.6	1.1

			Est Time (hr) Turb = 20 NTU	
Time	Port A	Port D	Port A	Port D
0.5	21.1	22.1	0.64	0.71
1.0	17.2	17.0		

Chemical =	**JC 1720**	
Date Run =	5/2/2005	(Run 23)
Water Source =	Rain Event, HY-89	
T=0 Temp (C) =	15.5	
T=8 Temp (C) =	15.0	
pH =	6.8	
EC (uS) =	684	
Target Dose (mg/L) =	200	
Actual Dose (mg/L) =	201	
	Turbidity (NTU)	
Time (hr)	Port A	Port D
0.00	310	310
0.0001	245	267
0.25	34.4	35.4
0.50	27.7	29.9
1.00	18.9	22.5
8.00	2.8	3.6
24.00	1.1	1.1

			Est Time (hr) Turb = 20 NTU	
Time	Port A	Port D	Port A	Port D
0.5	27.7	29.9	0.94	1.92
1.0	18.9	22.5		

Chemical =	**PAM #1 (Cytec A100)**	
Date Run =	5/2/2005	(Run 23)
Water Source =	Rain Event, HY-89	
T=0 Temp (C) =	11.4	
T=8 Temp (C) =	12.2	
pH =	7.6	
EC (uS) =	629	
Target Dose (mg/L) =	1.00	
Actual Dose (mg/L) =	0.99	
	Turbidity (NTU)	
Time (hr)	Port A	Port D
0.00	310	310
0.0001	158	196
0.25	135	139
0.50	117.0	124
1.00	106.0	113.0
8.00	68.1	72.6
24.00	42.7	52.6

			Est Time (hr) Turb = 20 NTU	
Time	Port A	Port D	Port A	Port D
8.0	68.1	72.6	38.3	50.1
24.0	42.7	52.6		

Chemical =	**No-Chem Control**	
Date Run =	5/2/2005	(Run 23)
Water Source =	Rain Event, HY-89	
T=0 Temp (C) =	11.4	
T=8 Temp (C) =	11.9	
pH =	7.6	
EC (uS) =	632	
Target Dose (mg/L) =	N/A	
Actual Dose (mg/L) =	N/A	
	Turbidity (NTU)	
Time (hr)	Port A	Port D
0.00	310	310
0.0001	295	305
0.25	273	298
0.50	263	279
1.00	260	268
8.00	231	236
24.00	166	206

			Est Time (hr) Turb = 20 NTU	
Time	Port A	Port D	Port A	Port D
8.0	231	236	59.9	123
24.0	166	206		

Table F-8, Chemically Enhanced Settling Test Data

(P = PAX) — **RUN 17A** — **Settling Test Data** — 15-Nov-04 — 70 mg/L

		Q	R	Phos-T	Q	R	Phos-D
Influent	17A-PINF	J	g	< 0.03			< 0.03
Inf Dup	17A-PINFD	J	g	0.08			< 0.03
	17A-PA-0			0.15			< 0.03
	17A-PD-0			0.14			< 0.03
Port D dup	17A-PDD-0			0.14			< 0.03
	17A-PA-0.25			0.07			0.05
	17A-PD-0.25			0.08			< 0.03
	17A-PA-0.5			0.06			< 0.03
	17A-PD-0.5			0.06			< 0.03
	17A-PA-1			0.04			< 0.03
	17A-PD-1			0.05			< 0.03
	17A-PA-8			< 0.03			< 0.03
	17A-PD-8			< 0.03			< 0.03
Btl blk	17A-PBL-0			< 0.03			< 0.03
Eq blk	17A-PEB-0			< 0.03			< 0.03

(J = JC 1720) — **RUN 17A** — **Settling Test Data** — 15-Nov-04 — 120 mg/L

		Q	R	Phos-T	Q	R	Phos-D
Influent	17A-JINF			0.09			< 0.03
Inf Dup	17A-JINFD			0.10			< 0.03
	17A-JA-0			0.08			< 0.03
	17A-JD-0			0.08			< 0.03
	17A-JA-0.25			0.03			< 0.03
	17A-JD-0.25			0.03			< 0.03
Port D dup	17A-JDD-0.25			0.03			< 0.03
	17A-JA-0.5			0.04			< 0.03
	17A-JD-0.5			< 0.03			< 0.03
	17A-JA-1			< 0.03			< 0.03
	17A-JD-1			< 0.03			< 0.03
	17A-JA-8			< 0.03			< 0.03
	17A-JD-8			< 0.03			< 0.03
Btl blk	17A-JBL-0.25			< 0.03			< 0.03
Eq blk	17A-JEB-0.25			< 0.03			< 0.03

(M = PAM A-100) — **RUN 17A** — **Settling Test Data** — 15-Nov-04 — 1.2 mg/L

		Q	R	Phos-T	Q	R	Phos-D
Influent	17A-MINF			0.12			< 0.03
Inf Dup	17A-MINFD			0.09			< 0.03
	17A-MA-0			0.08			0.05
	17A-MD-0			0.07			< 0.03
	17A-MA-0.25			0.06			< 0.03
	17A-MD-0.25			0.07			< 0.03
	17A-MA-0.5			0.06			< 0.03
	17A-MD-0.5			0.06			< 0.03
Port D dup	17A-MDD-0.5			0.06			< 0.03
	17A-MA-1			0.05			< 0.03
	17A-MD-1			0.04			< 0.03
	17A-MA-8			< 0.03			< 0.03
	17A-MD-8			0.03			< 0.03
Eq blk	17A-MEB-0.5			< 0.03			< 0.03

(C = Control) — **RUN 17A** — **Settling Test Data** — 15-Nov-04

		Q	R	Phos-T	Q	R	Phos-D
Influent	17A-CINF			0.12			< 0.03
Inf Dup	17A-CINFD			0.09			< 0.03
	17A-CA-0			0.08			0.04
	17A-CD-0			0.08			< 0.03
	17A-CA-0.25			0.07			< 0.03
	17A-CD-0.25			0.07			< 0.03
	17A-CA-0.5			0.07			< 0.03
	17A-CD-0.5			0.07			< 0.03
	17A-CA-1			0.08			< 0.03
	17A-CD-1			0.08			0.05
Port D dup	17A-CDD-1			0.08			< 0.03
	17A-CA-8			0.07			< 0.03
	17A-CD-8			0.07			< 0.03
Eq blk	17A-CEB-1			< 0.03			< 0.03

Table F-8 (Continued) Chemically Enhanced Settling Test Data

RUN 18 (P = PAX)	Settling Test Data	Q	R	Phos-T	Q	R	Phos-D (12-Dec-04, 100 mg/L)
Influent	18-PINF			0.32	<		0.03
Inf Dup	18-PINFD			0.41	<		0.03
	18-PA-0			0.49	<		0.03
	18-PD-0			0.48	<		0.03
Port D dup	18-PDD-0			0.49	<		0.03
	18-PA-0.25			0.18	<		0.03
	18-PD-0.25			0.20	<		0.03
	18-PA-0.5			0.16	<		0.03
	18-PD-0.5			0.17	<		0.03
	18-PA-1			0.15	<		0.03
	18-PD-1			0.16	<		0.03
	18-PA-8			0.03	<		0.03
	18-PD-8			0.08	<		0.03
Btl blk	18-PBL-0	<		0.03	<		0.03
Eq blk	18-PEB-0	<		0.03	<		0.03

RUN 18 (J = JC 1720)	Settling Test Data	Q	R	Phos-T	Q	R	Phos-D (12-Dec-04, 80 mg/L)
Influent	18-JINF			0.31	<		0.03
Inf Dup	18-JINFD			0.33	<		0.03
	18-JA-0			0.29	<		0.03
	18-JD-0			0.31	<		0.03
	18-JA-0.25			0.15	<		0.03
	18-JD-0.25			0.13	<		0.03
Port D dup	18-JDD-0.25			0.14	<		0.03
	18-JA-0.5			0.10	<		0.03
	18-JD-0.5			0.12	<		0.03
	18-JA-1			0.11	<		0.03
	18-JD-1			0.08	<		0.03
	18-JA-8	<		0.03	<		0.03
	18-JD-8	<		0.03	<		0.03
Btl blk	18-JBL-0.25	<		0.03	<		0.03
Eq blk	18-JEB-0.25	<		0.03	<		0.03

RUN 18 (M = PAM A-100)	Settling Test Data	Q	R	Phos-T	Q	R	Phos-D (12-Dec-04, 0.50 mg/L)
Influent	18-MINF			0.23	<		0.03
Inf Dup	18-MINFD			0.21	<		0.03
	18-MA-0			0.04	<		0.03
	18-MD-0			0.20	<		0.03
	18-MA-0.25			0.18	<		0.03
	18-MD-0.25			0.18	<		0.03
	18-MA-0.5			0.18	<		0.03
	18-MD-0.5			0.17	<		0.03
Port D dup	18-MDD-0.5			0.17	<		0.03
	18-MA-1			0.14	<		0.03
	18-MD-1			0.17	<		0.03
	18-MA-8			0.19	<		0.03
	18-MD-8			0.20	<		0.03
Eq blk	18-MEB-0.5	<		0.03	<		0.03

RUN 18 (C = Control)	Settling Test Data	Q	R	Phos-T	Q	R	Phos-D (12-Dec-04)
Influent	18-CINF			0.32	<		0.03
Inf Dup	18-CINFD			0.31	<		0.03
	18-CA-0			0.32	<		0.03
	18-CD-0			0.35	<		0.03
	18-CA-0.25			0.33	<		0.03
	18-CD-0.25			0.32	<		0.03
	18-CA-0.5			0.34	<		0.03
	18-CD-0.5			0.32	<		0.03
	18-CA-1			0.32	<		0.03
	18-CD-1			0.31	<		0.03
Port D dup	18-CDD-1			0.32	<		0.03
	18-CA-8			0.16	<		0.03
	18-CD-8			0.17	<		0.03
Eq blk	18-CEB-1	<		0.03	<		0.03

Table F-8 (Continued) Chemically Enhanced Settling Test Data

(P = PAX)	RUN 19	Q	R	Settling Test Data Phos-T	Q	R	19-Dec-04 100 mg/L Phos-D
Influent	19-PINF			0.40			< 0.03
Inf Dup	19-PINFD			0.39			< 0.03
	19-PA-0			0.43			< 0.03
	19-PD-0			0.49			< 0.03
Port D dup	19-PDD-0			0.49			< 0.03
	19-PA-0.25			0.04			< 0.03
	19-PD-0.25			0.05			< 0.03
	19-PA-0.5			< 0.03			< 0.03
	19-PD-0.5			< 0.03			< 0.03
	19-PA-1			0.03			< 0.03
	19-PD-1			0.04			< 0.03
	19-PA-8			< 0.03			< 0.03
	19-PD-8			< 0.03			< 0.03
Btl blk	19-PBL-0			< 0.03			< 0.03
Eq blk	19-PEB-0			< 0.03			< 0.03

(J = JC 1720)	RUN 19	Q	R	Settling Test Data Phos-T	Q	R	19-Dec-04 30 mg/L Phos-D
Influent	19-JINF			0.40			< 0.03
Inf Dup	19-JINFD			0.40			< 0.03
	19-JA-0			0.15			< 0.03
	19-JD-0			0.14			< 0.03
	19-JA-0.25			< 0.03			< 0.03
	19-JD-0.25			< 0.03			< 0.03
Port D dup	19-JDD-0.25			< 0.03			< 0.03
	19-JA-0.5			< 0.03			< 0.03
	19-JD-0.5			< 0.03			< 0.03
	19-JA-1			< 0.03			< 0.03
	19-JD-1			< 0.03			< 0.03
	19-JA-8			< 0.03			< 0.03
	19-JD-8			< 0.03			< 0.03
Btl blk	19-JBL-0.25			< 0.03			< 0.03
Eq blk	19-JEB-0.25			< 0.03			< 0.03

(M = PAM A-100)	RUN 19	Q	R	Settling Test Data Phos-T	Q	R	19-Dec-04 2.75 mg/L Phos-D
Influent	19-MINF			0.41			< 0.03
Inf Dup	19-MINFD			0.42			< 0.03
	19-MA-0			0.13			< 0.03
	19-MD-0			0.12			< 0.03
	19-MA-0.25			0.10			< 0.03
	19-MD-0.25			0.10			< 0.03
	19-MA-0.5			0.08			< 0.03
	19-MD-0.5			0.07			< 0.03
Port D dup	19-MDD-0.5			0.08			< 0.03
	19-MA-1			< 0.03			< 0.03
	19-MD-1			0.06			< 0.03
	19-MA-8			0.07			< 0.03
	19-MD-8			0.03			< 0.03
Eq blk	19-MEB-0.5			< 0.03			< 0.03

(C = Control)	RUN 19	Q	R	Settling Test Data Phos-T	Q	R	19-Dec-04 Phos-D
Influent	19-CINF			0.40			< 0.03
Inf Dup	19-CINFD			0.36			< 0.03
	19-CA-0			0.39			< 0.03
	19-CD-0			0.57			< 0.03
	19-CA-0.25			0.35			< 0.03
	19-CD-0.25			0.39			< 0.03
	19-CA-0.5			0.37			< 0.03
	19-CD-0.5			0.40			< 0.03
	19-CA-1			0.37			< 0.03
	19-CD-1			0.36			< 0.03
Port D dup	19-CDD-1			0.26			< 0.03
	19-CA-8			0.27			< 0.03
	19-CD-8			0.32			< 0.03
Eq blk	19-CEB-1			< 0.03			< 0.03

Table F-8 (Continued) Chemically Enhanced Settling Test Data

RUN 20 Settling Test Data 14-Mar-05
(P = PAX) 290 mg/L

		Q	R	Phos-T	Q	R	Phos-D
Influent	20-PINF			1.68			0.06
Inf Dup	20-PINFD			1.74			< 0.03
	20-PA-0			2.20			< 0.03
	20-PD-0			2.36			< 0.03
Port D dup	20-PDD-0			2.23			< 0.03
	20-PA-0.25			0.04			< 0.03
	20-PD-0.25			0.11			< 0.03
	20-PA-0.5			0.08			< 0.03
	20-PD-0.5			0.15			< 0.03
	20-PA-1			0.11			< 0.03
	20-PD-1			0.09			< 0.03
	20-PA-8			< 0.03			< 0.03
	20-PD-8			< 0.03			< 0.03
Btl blk	20-PBL-0			0.03			< 0.03
Eq blk	20-PEB-0			< 0.03			< 0.03

RUN 20 Settling Test Data 14-Mar-05
(J = JC 1720) 240 mg/L

		Q	R	Phos-T	Q	R	Phos-D
Influent	20-JINF			1.12			0.08
Inf Dup	20-JINFD			1.16			0.07
	20-JA-0			1.61			< 0.03
	20-JD-0			1.62			< 0.03
	20-JA-0.25			0.04			< 0.03
	20-JD-0.25			0.04			< 0.03
Port D dup	20-JDD-0.25			< 0.03			< 0.03
	20-JA-0.5			0.03			< 0.03
	20-JD-0.5			0.14			< 0.03
	20-JA-1			0.03			< 0.03
	20-JD-1			0.03			< 0.03
	20-JA-8			0.03			< 0.03
	20-JD-8			< 0.03			< 0.03
Btl blk	20-JBL-0.25			< 0.03			< 0.03
Eq blk	20-JEB-0.25			< 0.03			< 0.03

RUN 20 Settling Test Data 14-Mar-05
(M = PAM A-100) 10.0 mg/L

		Q	R	Phos-T	Q	R	Phos-D
Influent	20-MINF			1.63			0.10
Inf Dup	20-MINFD			1.63			0.12
	20-MA-0			0.23			< 0.03
	20-MD-0			0.33			0.05
	20-MA-0.25			0.13			< 0.03
	20-MD-0.25			0.14			0.03
	20-MA-0.5			0.13			0.05
	20-MD-0.5			0.13			0.04
Port D dup	20-MDD-0.5			0.11			0.04
	20-MA-1			0.10			0.04
	20-MD-1			0.10			0.04
	20-MA-8			0.12			< 0.03
	20-MD-8			0.15			< 0.03
Eq blk	20-MEB-0.5			< 0.03			< 0.03

RUN 20 Settling Test Data 14-Mar-05
(C = Control)

		Q	R	Phos-T	Q	R	Phos-D
Influent	20-CINF			1.35			0.05
Inf Dup	20-CINFD			1.25			0.05
	20-CA-0			1.48			0.05
	20-CD-0			1.60			0.05
	20-CA-0.25			1.70			< 0.03
	20-CD-0.25			1.68			< 0.03
	20-CA-0.5			1.60			< 0.03
	20-CD-0.5			1.50			0.10
	20-CA-1			1.45			0.04
	20-CD-1			1.47			0.17
Port D dup	20-CDD-1			1.44			0.05
	20-CA-8			0.56			< 0.03
	20-CD-8			1.09			< 0.03
Eq blk	20-CEB-1			0.08			< 0.03

Table F-8 (Continued) Chemically Enhanced Settling Test Data

(P = PAX)	RUN 21	Q	R	Phos-T	Q	R	Phos-D
	Settling Test Data 24-Mar-05 90 mg/L						
Influent	21-PINF			0.64			< 0.03
Inf Dup	21-PINFD			0.76			0.03
	21-PA-0			0.81			< 0.03
	21-PD-0			0.71			< 0.03
Port D dup	21-PDD-0			0.64			< 0.03
	21-PA-0.25			0.20			< 0.03
	21-PD-0.25			0.19			< 0.03
	21-PA-0.5			0.12			< 0.03
	21-PD-0.5			0.13			< 0.03
	21-PA-1			0.15			< 0.03
	21-PD-1			0.09			< 0.03
	21-PA-8			< 0.03			< 0.03
	21-PD-8			< 0.03			< 0.03
Btl blk	21-PBL-0			< 0.03			< 0.03
Eq blk	21-PEB-0			0.04			< 0.03

(J = JC 1720)	RUN 21	Q	R	Phos-T	Q	R	Phos-D
	Settling Test Data 24-Mar-05 100 mg/L						
Influent	21-JINF			0.68			0.03
Inf Dup	21-JINFD			0.65			0.05
	21-JA-0			0.58			< 0.03
	21-JD-0			0.59			< 0.03
	21-JA-0.25			0.15			< 0.03
	21-JD-0.25			0.16			< 0.03
Port D dup	21-JDD-0.25			0.16			< 0.03
	21-JA-0.5			0.13			< 0.03
	21-JD-0.5			0.14			< 0.03
	21-JA-1			0.09			< 0.03
	21-JD-1			0.04			< 0.03
	21-JA-8			< 0.03			< 0.03
	21-JD-8			< 0.03			< 0.03
Btl blk	21-JBL-0.25			< 0.03			< 0.03
Eq blk	21-JEB-0.25			< 0.03			< 0.03

(M = PAM A-100)	RUN 21	Q	R	Phos-T	Q	R	Phos-D
	Settling Test Data 24-Mar-05 0,35 mg/L						
Influent	21-MINF			0.52			< 0.03
Inf Dup	21-MINFD			0.52			< 0.03
	21-MA-0			0.67			0.03
	21-MD-0			0.66			0.03
	21-MA-0.25			0.53			0.04
	21-MD-0.25			0.59			0.04
	21-MA-0.5			0.48			0.03
	21-MD-0.5			0.49			0.04
Port D dup	21-MDD-0.5			0.45			< 0.03
	21-MA-1			0.41			< 0.03
	21-MD-1			0.42			< 0.03
	21-MA-8			0.32			< 0.03
	21-MD-8			0.33			< 0.03
Eq blk	21-MEB-0.5			< 0.03			< 0.03

(C = Control)	RUN 21	Q	R	Phos-T	Q	R	Phos-D
	Settling Test Data 24-Mar-05						
Influent	21-CINF			0.58			0.04
Inf Dup	21-CINFD			0.64			0.04
	21-CA-0			0.60			< 0.03
	21-CD-0			0.59			0.04
	21-CA-0.25			0.60			0.04
	21-CD-0.25			0.68			0.04
	21-CA-0.5			0.53			< 0.03
	21-CD-0.5			0.54			< 0.03
	21-CA-1			0.62			< 0.03
	21-CD-1			0.51			< 0.03
Port D dup	21-CDD-1			0.52			< 0.03
	21-CA-8			0.44			< 0.03
	21-CD-8			0.47			< 0.03
Eq blk	21-CEB-1			< 0.03			< 0.03

Table F-8 (Continued) Chemically Enhanced Settling Test Data

(P = PAX)	RUN 22	Settling Test Data Q	R	Phos-T	Q	R	29-Apr-05 125 mg/L Phos-D
Influent	22-PINF			0.47			0.19
Inf Dup	22-PINFD			0.62			0.18
	22-PA-0			0.64			< 0.03
	22-PD-0			0.66			< 0.03
Port D dup	22-PDD-0			0.69			< 0.03
	22-PA-0.25			0.23			< 0.03
	22-PD-0.25			0.22			< 0.03
	22-PA-0.5			0.22			< 0.03
	22-PD-0.5			0.22			< 0.03
	22-PA-1			0.22			< 0.03
	22-PD-1			0.22			< 0.03
	22-PA-8			0.15			< 0.03
	22-PD-8			0.14			< 0.03
Btl blk	22-PBL-0			< 0.03			< 0.03
Eq blk	22-PEB-0			< 0.03			< 0.03

(J = JC 1720)	RUN 22	Settling Test Data Q	R	Phos-T	Q	R	29-Apr-05 175 mg/L Phos-D
Influent	22-JINF			0.53			0.18
Inf Dup	22-JINFD			0.47			0.18
	22-JA-0			0.32			0.17
	22-JD-0			0.56			0.18
	22-JA-0.25			0.18			< 0.03
	22-JD-0.25			0.19			< 0.03
Port D dup	22-JDD-0.25			0.18			< 0.03
	22-JA-0.5			0.18			< 0.03
	22-JD-0.5			0.18			< 0.03
	22-JA-1			0.17			< 0.03
	22-JD-1			0.16			< 0.03
	22-JA-8			0.12			< 0.03
	22-JD-8			0.15			< 0.03
Btl blk	22-JBL-0.25			< 0.03			< 0.03
Eq blk	22-JEB-0.25			< 0.03			< 0.03

(M = PAM A-100)	RUN 22	Settling Test Data Q	R	Phos-T	Q	R	29-Apr-05 4.00 mg/L Phos-D
Influent	22-MINF			0.62			0.18
Inf Dup	22-MINFD			0.48			0.18
	22-MA-0			0.34			0.17
	22-MD-0			0.35			0.19
	22-MA-0.25			0.30			0.19
	22-MD-0.25			0.30			0.20
	22-MA-0.5			0.28			0.19
	22-MD-0.5			0.29			0.18
Port D dup	22-MDD-0.5			0.28			0.18
	22-MA-1			0.26			0.18
	22-MD-1			0.27			0.19
	22-MA-8			0.55			0.21
	22-MD-8			0.28			0.21
Eq blk	22-MEB-0.5			< 0.03			< 0.03

(C = Control)	RUN 22	Settling Test Data Q	R	Phos-T	Q	R	29-Apr-05 Phos-D
Influent	22-CINF			0.46			0.18
Inf Dup	22-CINFD			0.52			0.17
	22-CA-0			0.64			0.19
	22-CD-0			0.54			0.19
	22-CA-0.25			0.51			0.21
	22-CD-0.25			0.51			0.18
	22-CA-0.5			0.67			0.17
	22-CD-0.5			0.58			0.17
	22-CA-1			0.60			0.19
	22-CD-1			0.51			0.17
Port D dup	22-CDD-1			0.47			0.19
	22-CA-8			0.20			0.20
	22-CD-8			0.53			0.20
Eq blk	22-CEB-1			< 0.03			< 0.03

Table F-8 (Continued) Chemically Enhanced Settling Test Data

(P = PAX)	RUN 23	Q	R	Settling Test Data Phos-T	Q	R	2-May-05 250 mg/L Phos-D
Influent	23-PINF			0.53			0.18
Inf Dup	23-PINFD			0.51			0.16
	23-PA-0			0.43			< 0.03
	23-PD-0			0.57			< 0.03
Port D dup	23-PDD-0			0.67			< 0.03
	23-PA-0.25			0.23			< 0.03
	23-PD-0.25			0.24			< 0.03
	23-PA-0.5			0.22			< 0.03
	23-PD-0.5			0.23			< 0.03
	23-PA-1			0.21			< 0.03
	23-PD-1			0.21			< 0.03
	23-PA-8			< 0.03			< 0.03
	23-PD-8			< 0.03			< 0.03
Btl blk	23-PBL-0			< 0.03			< 0.03
Eq blk	23-PEB-0			< 0.03			< 0.03

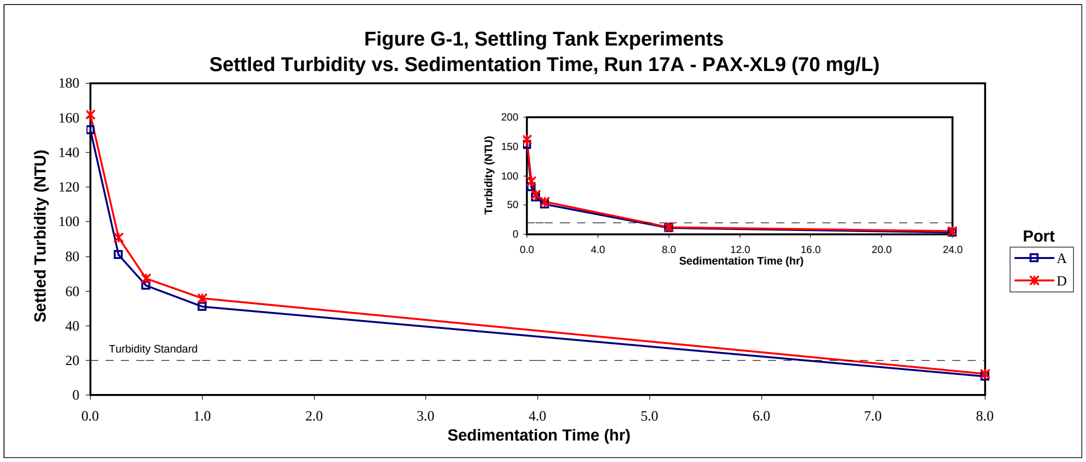
(J = JC 1720)	RUN 23	Q	R	Settling Test Data Phos-T	Q	R	2-May-05 200 mg/L Phos-D
Influent	23-JINF			0.55			0.15
Inf Dup	23-JINFD			0.70			0.15
	23-JA-0			0.37			< 0.03
	23-JD-0			0.43			< 0.03
	23-JA-0.25			0.19			< 0.03
	23-JD-0.25			< 0.03			< 0.03
Port D dup	23-JDD-0.25			< 0.03			< 0.03
	23-JA-0.5			0.18			< 0.03
	23-JD-0.5			< 0.03			< 0.03
	23-JA-1			< 0.03			< 0.03
	23-JD-1			< 0.03			< 0.03
	23-JA-8			< 0.03			< 0.03
	23-JD-8			< 0.03			< 0.03
Btl blk	23-JBL-0.25			< 0.03			< 0.03
Eq blk	23-JEB-0.25			< 0.03			< 0.03

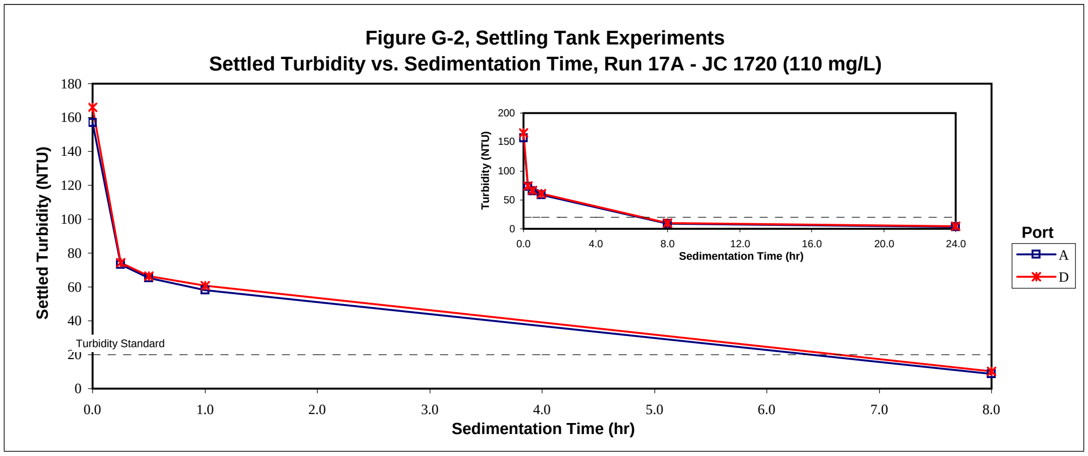
(M = PAM A-100)	RUN 23	Q	R	Settling Test Data Phos-T	Q	R	2-May-05 0.50 mg/L Phos-D
Influent	23-MINF			0.51			0.19
Inf Dup	23-MINFD			0.51			0.19
	23-MA-0			0.41			0.17
	23-MD-0			0.42			0.17
	23-MA-0.25			0.32			0.17
	23-MD-0.25			0.33			0.16
	23-MA-0.5			0.29			0.18
	23-MD-0.5			0.32			0.17
Port D dup	23-MDD-0.5			0.40			0.17
	23-MA-1			0.31			0.24
	23-MD-1			0.31			0.18
	23-MA-8			0.28			0.27
	23-MD-8			0.29			< 0.03
Eq blk	23-MEB-0.5			< 0.03			< 0.03

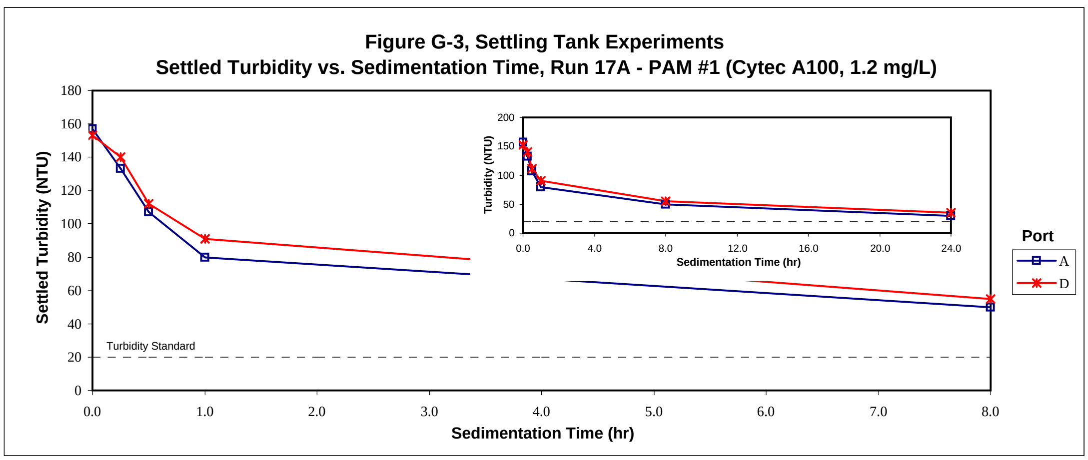
(C = Control)	RUN 23	Q	R	Settling Test Data Phos-T	Q	R	2-May-05 Phos-D
Influent	23-CINF			0.52			0.19
Inf Dup	23-CINFD			0.55			0.18
	23-CA-0			0.65			0.18
	23-CD-0			0.49			0.18
	23-CA-0.25			0.45			0.18
	23-CD-0.25			0.60			0.18
	23-CA-0.5			0.47			0.18
	23-CD-0.5			0.65			0.18
	23-CA-1			0.45			0.20
	23-CD-1			0.46			0.20
Port D dup	23-CDD-1			0.44			0.19
	23-CA-8			0.48			< 0.03
	23-CD-8			0.40			0.29
Eq blk	23-CEB-1			< 0.03			< 0.03

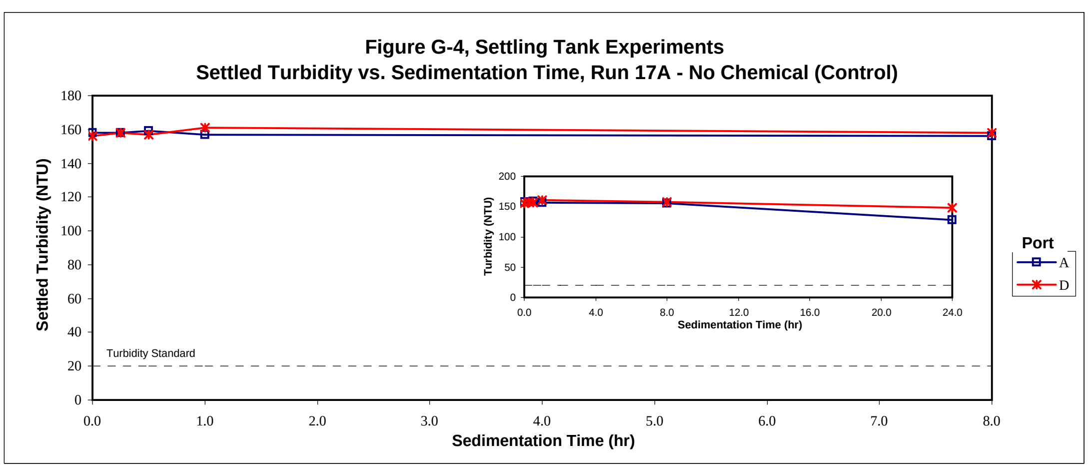
Appendix G

Chemically Enhanced Sedimentation Experiments – Graphs









Run 17A, 11/12/04 (on-site basin)

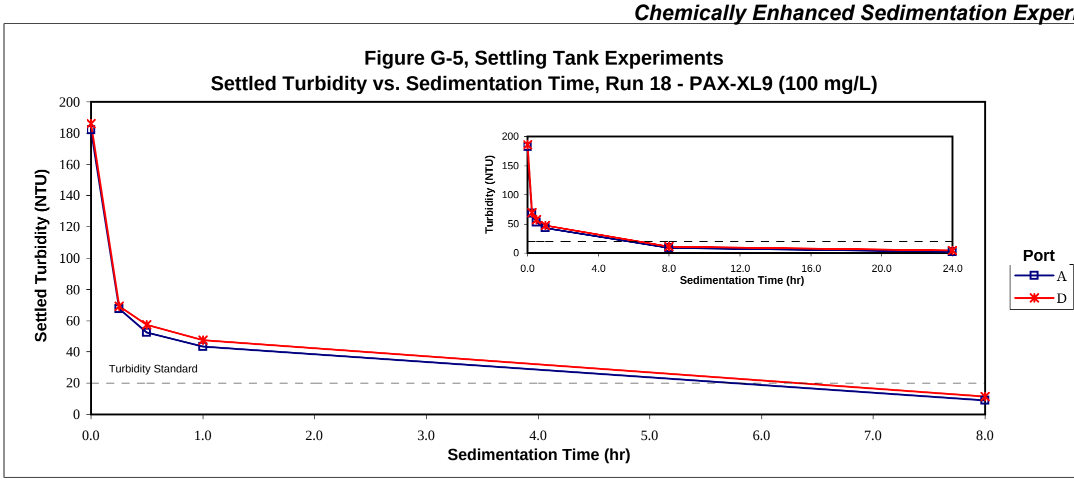


Figure G-5, Settling Tank Experiments
Settled Turbidity vs. Sedimentation Time, Run 18 - PAX-XL9 (100 mg/L)
Settled Turbidity (NTU)
Sedimentation Time (hr)
Turbidity Standard
Turbidity (NTU)
Port
A
D

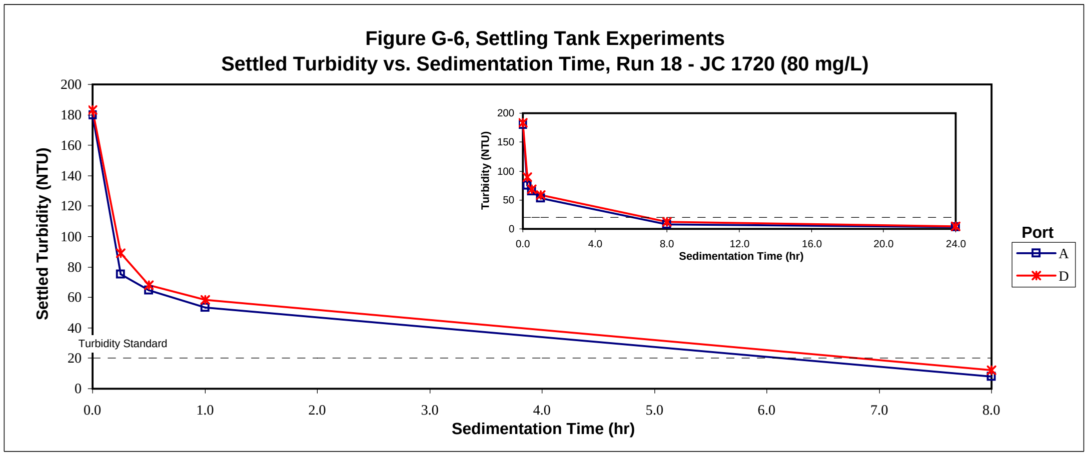


Figure G-6, Settling Tank Experiments
Settled Turbidity vs. Sedimentation Time, Run 18 - JC 1720 (80 mg/L)
Settled Turbidity (NTU)
Sedimentation Time (hr)
Turbidity Standard
Turbidity (NTU)
Port
A
D

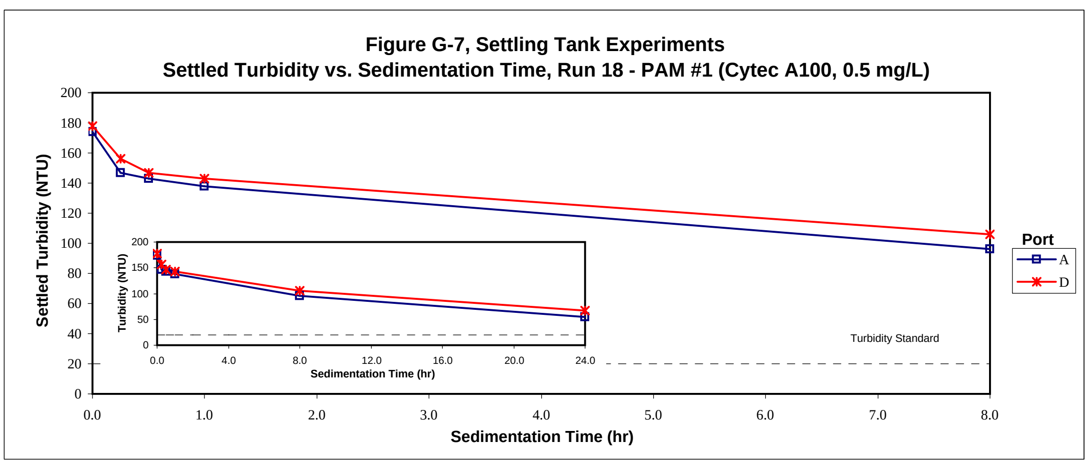


Figure G-7, Settling Tank Experiments
Settled Turbidity vs. Sedimentation Time, Run 18 - PAM #1 (Cytec A100, 0.5 mg/L)
Settled Turbidity (NTU)
Sedimentation Time (hr)
Turbidity Standard
Turbidity (NTU)
Port
A
D

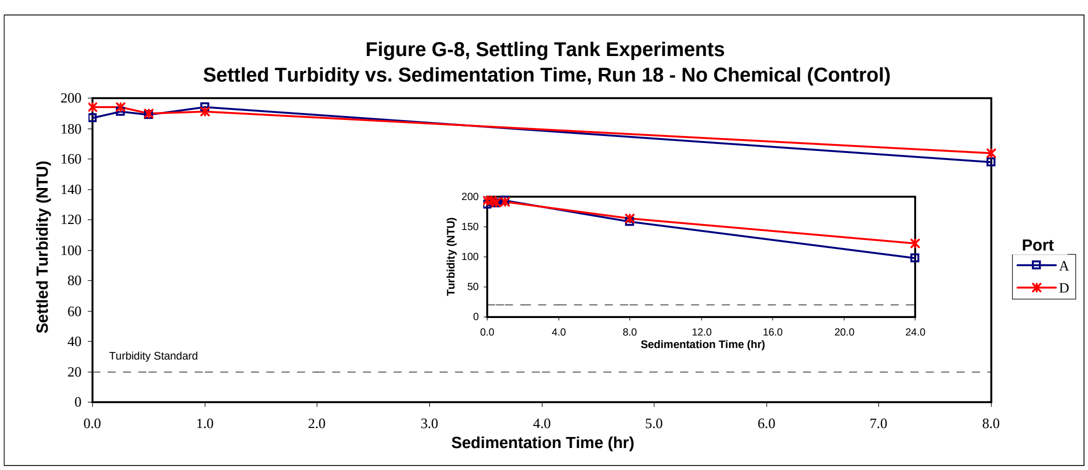


Figure G-8, Settling Tank Experiments
Settled Turbidity vs. Sedimentation Time, Run 18 - No Chemical (Control)
Settled Turbidity (NTU)
Sedimentation Time (hr)
Turbidity Standard
Turbidity (NTU)
Port
A
D

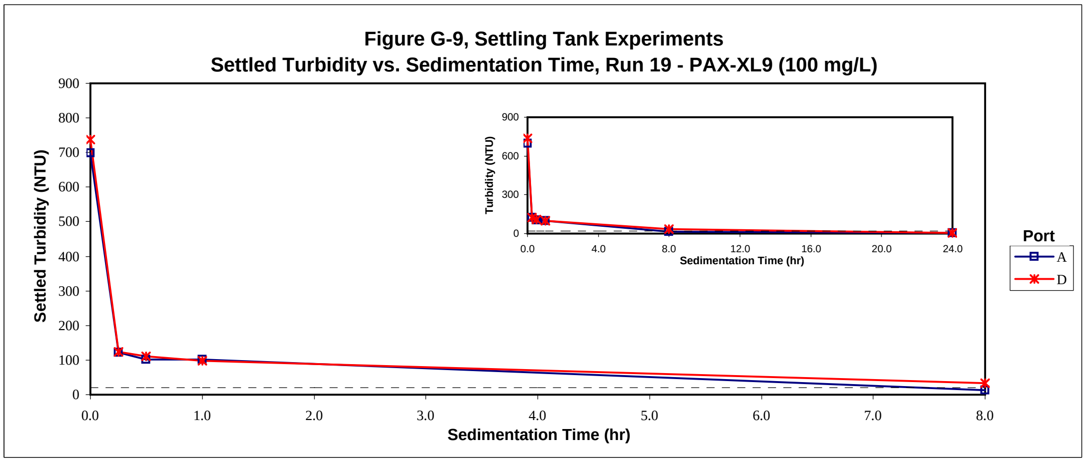


Figure G-9, Settling Tank Experiments
Settled Turbidity vs. Sedimentation Time, Run 19 - PAX-XL9 (100 mg/L)
Settled Turbidity (NTU)
Sedimentation Time (hr)
Turbidity (NTU)
Sedimentation Time (hr)
Port
A
D

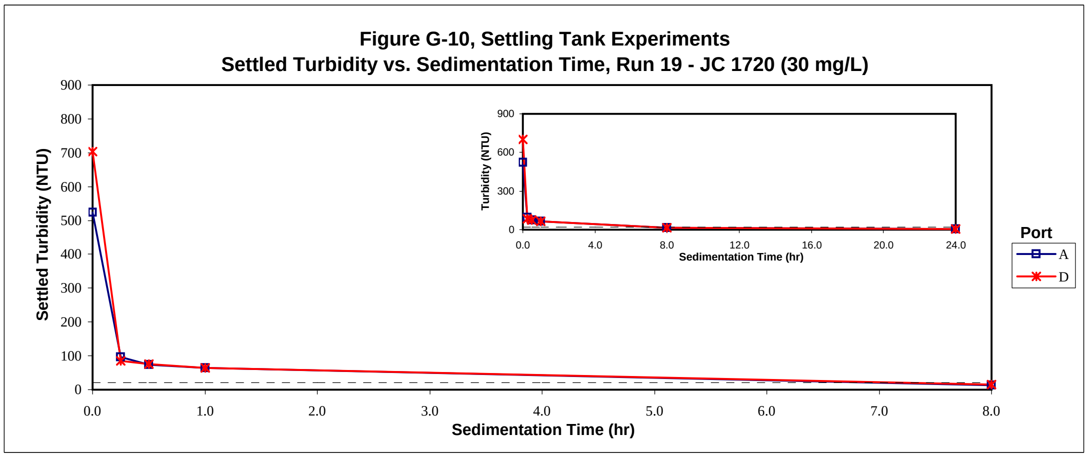


Figure G-10, Settling Tank Experiments
Settled Turbidity vs. Sedimentation Time, Run 19 - JC 1720 (30 mg/L)
Settled Turbidity (NTU)
Sedimentation Time (hr)
Turbidity (NTU)
Sedimentation Time (hr)
Port
A
D

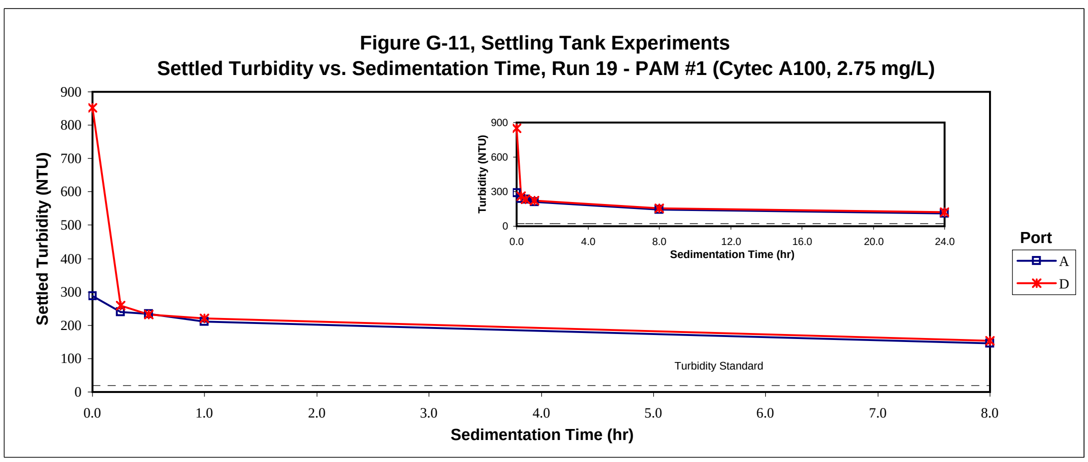


Figure G-11, Settling Tank Experiments
Settled Turbidity vs. Sedimentation Time, Run 19 - PAM #1 (Cytec A100, 2.75 mg/L)
Settled Turbidity (NTU)
Sedimentation Time (hr)
Turbidity (NTU)
Sedimentation Time (hr)
Turbidity Standard
Port
A
D

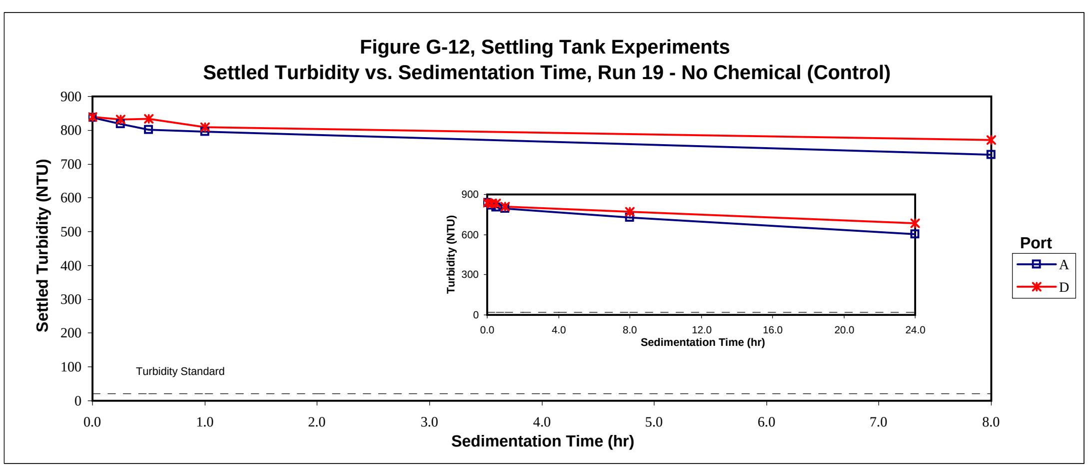


Figure G-12, Settling Tank Experiments
Settled Turbidity vs. Sedimentation Time, Run 19 - No Chemical (Control)
Settled Turbidity (NTU)
Sedimentation Time (hr)
Turbidity (NTU)
Sedimentation Time (hr)
Turbidity Standard
Port
A
D

Figure G-13, Settling Tank Experiments
Settled Turbidity vs. Sedimentation Time, Run 20 - PAX-XL9 (290 mg/L)

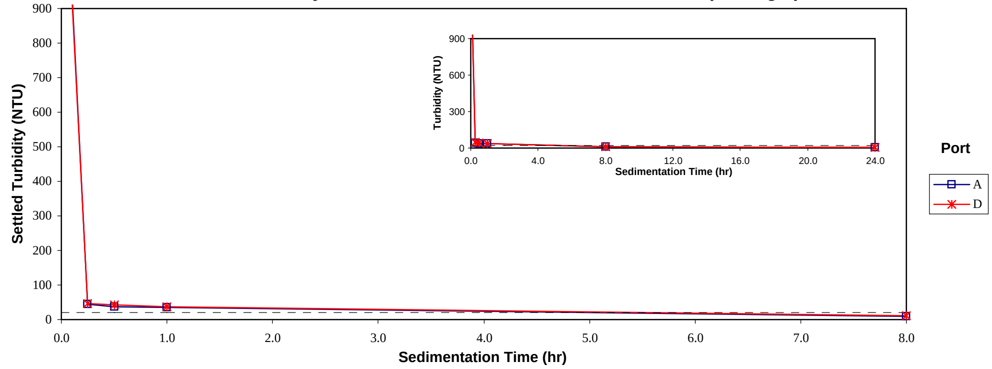


Figure G-14, Settling Tank Experiments
Settled Turbidity vs. Sedimentation Time, Run 20 - JC 1720 (240 mg/L)

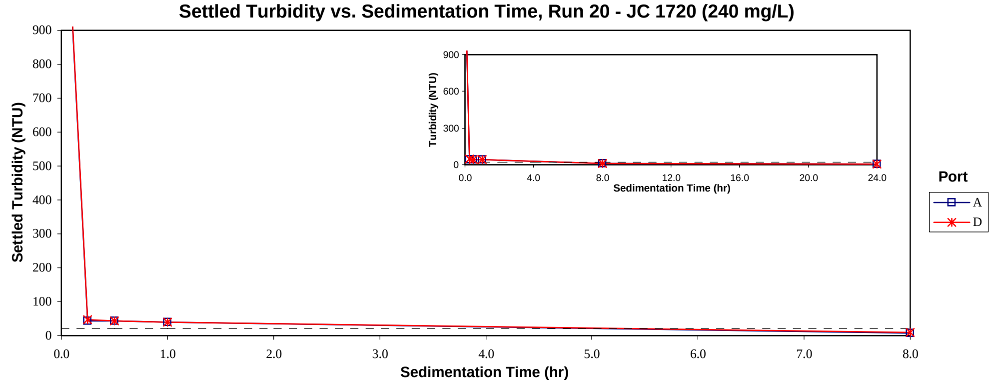


Figure G-15, Settling Tank Experiments
Settled Turbidity vs. Sedimentation Time, Run 20 - PAM #1 (Cytec A100, 10 mg/L)

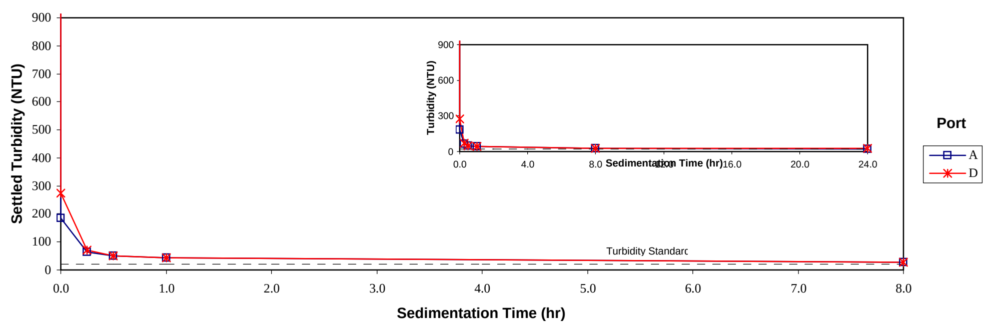
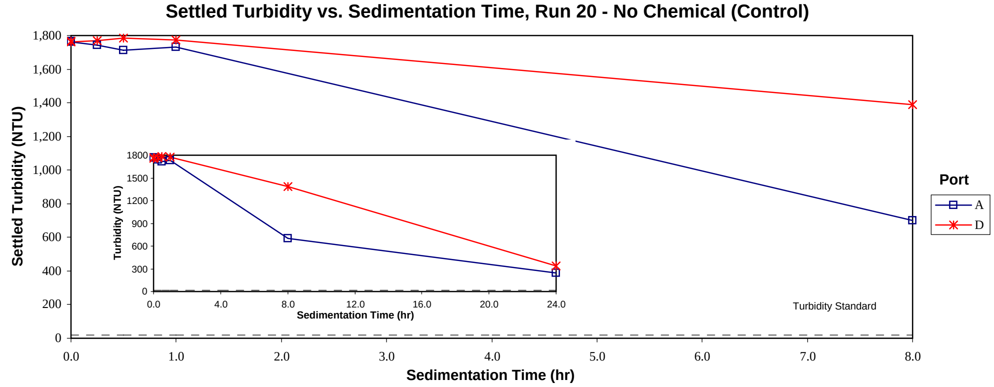


Figure G-16, Settling Tank Experiments
Settled Turbidity vs. Sedimentation Time, Run 20 - No Chemical (Control)



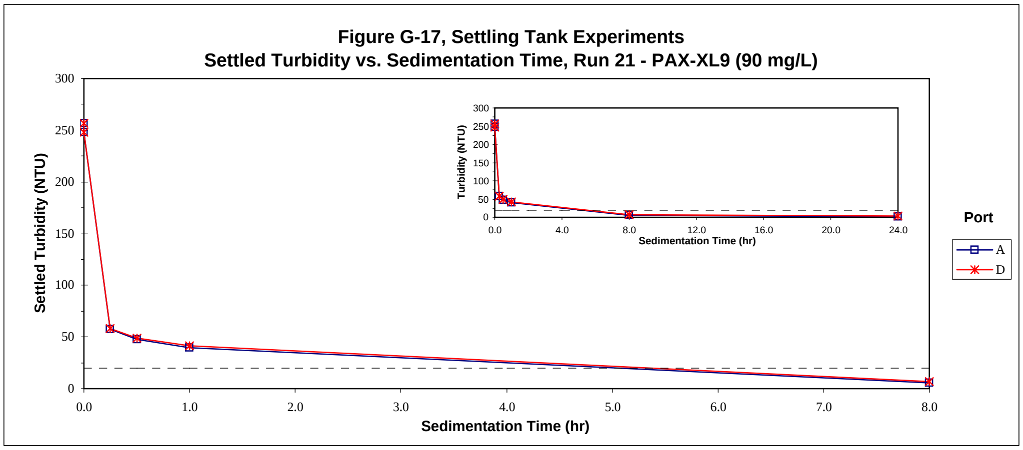


Figure G-17, Settling Tank Experiments
Settled Turbidity vs. Sedimentation Time, Run 21 - PAX-XL9 (90 mg/L)
Settled Turbidity (NTU)
Sedimentation Time (hr)
Turbidity (NTU)
Port
A
D

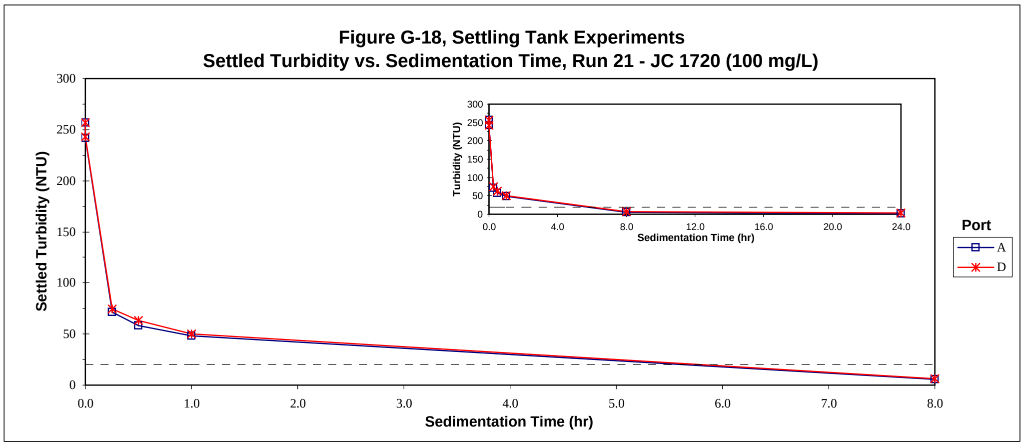


Figure G-18, Settling Tank Experiments
Settled Turbidity vs. Sedimentation Time, Run 21 - JC 1720 (100 mg/L)
Settled Turbidity (NTU)
Sedimentation Time (hr)
Turbidity (NTU)
Port
A
D

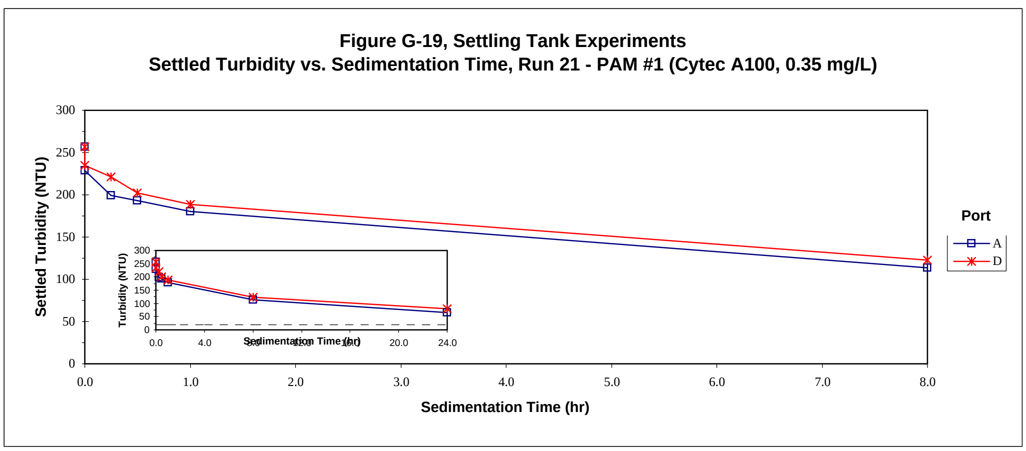


Figure G-19, Settling Tank Experiments
Settled Turbidity vs. Sedimentation Time, Run 21 - PAM #1 (Cytec A100, 0.35 mg/L)
Settled Turbidity (NTU)
Sedimentation Time (hr)
Turbidity (NTU)
Port
A
D

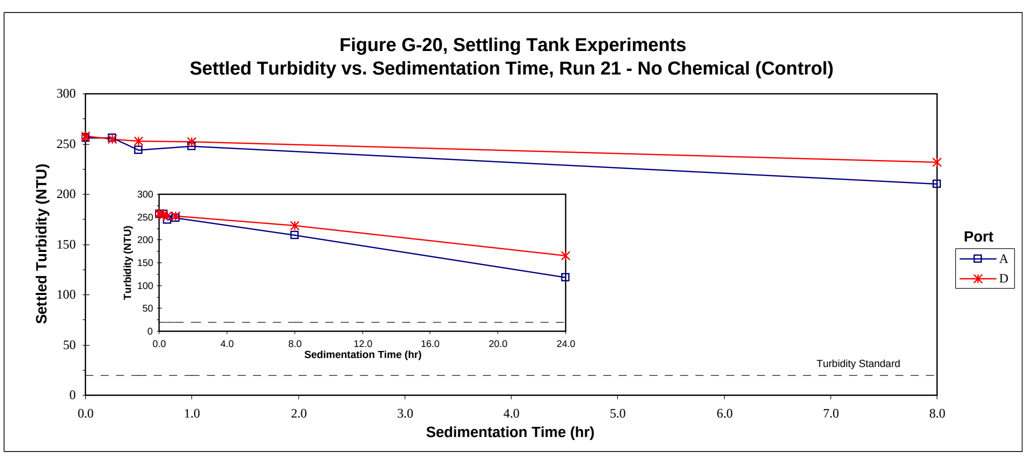


Figure G-20, Settling Tank Experiments
Settled Turbidity vs. Sedimentation Time, Run 21 - No Chemical (Control)
Settled Turbidity (NTU)
Sedimentation Time (hr)
Turbidity (NTU)
Turbidity Standard
Port
A
D

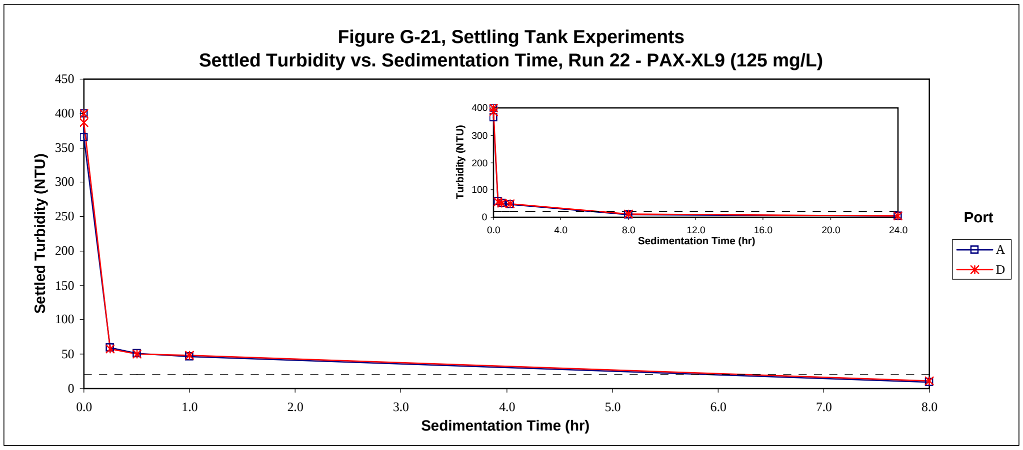


Figure G-21, Settling Tank Experiments
Settled Turbidity vs. Sedimentation Time, Run 22 - PAX-XL9 (125 mg/L)
Settled Turbidity (NTU)
Sedimentation Time (hr)
Turbidity (NTU)
Port
A
D

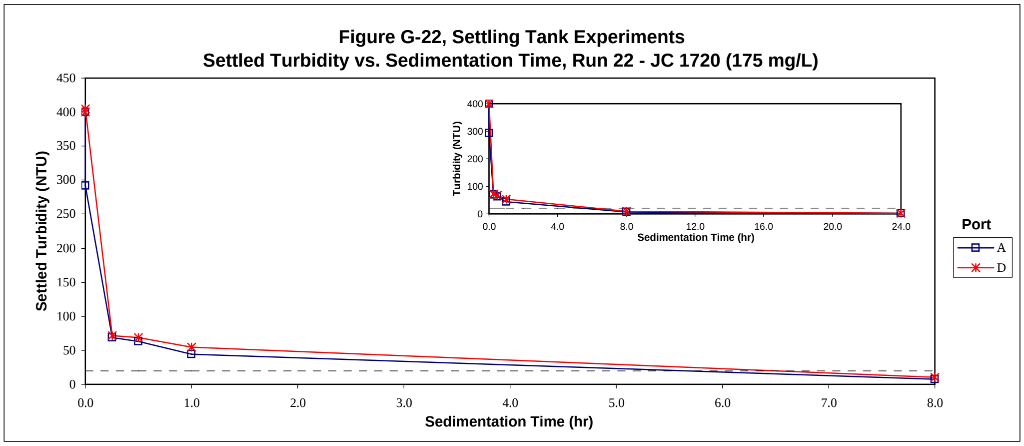


Figure G-22, Settling Tank Experiments
Settled Turbidity vs. Sedimentation Time, Run 22 - JC 1720 (175 mg/L)
Settled Turbidity (NTU)
Sedimentation Time (hr)
Turbidity (NTU)
Port
A
D

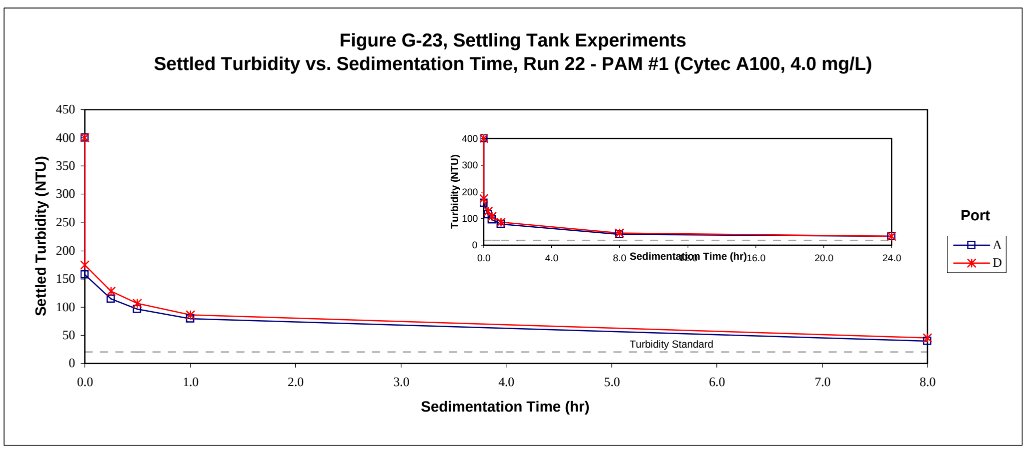


Figure G-23, Settling Tank Experiments
Settled Turbidity vs. Sedimentation Time, Run 22 - PAM #1 (Cytec A100, 4.0 mg/L)
Settled Turbidity (NTU)
Sedimentation Time (hr)
Turbidity (NTU)
Turbidity Standard
Port
A
D

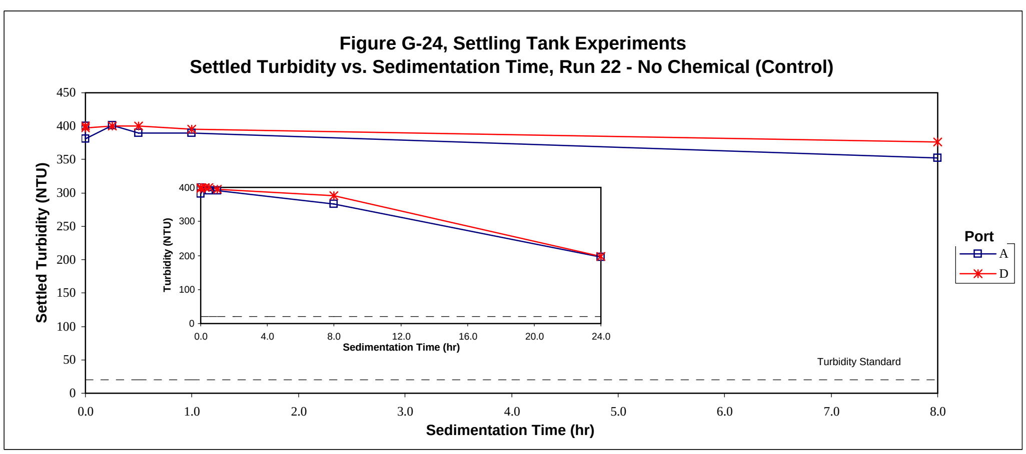


Figure G-24, Settling Tank Experiments
Settled Turbidity vs. Sedimentation Time, Run 22 - No Chemical (Control)
Settled Turbidity (NTU)
Sedimentation Time (hr)
Turbidity (NTU)
Turbidity Standard
Port
A
D

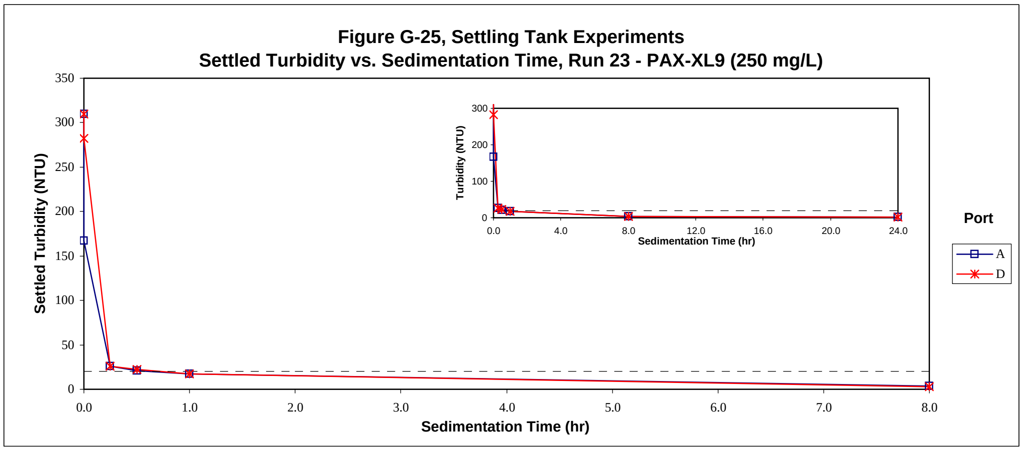


Figure G-25, Settling Tank Experiments
Settled Turbidity vs. Sedimentation Time, Run 23 - PAX-XL9 (250 mg/L)
Settled Turbidity (NTU)
Sedimentation Time (hr)
Turbidity (NTU)
Port
A
D

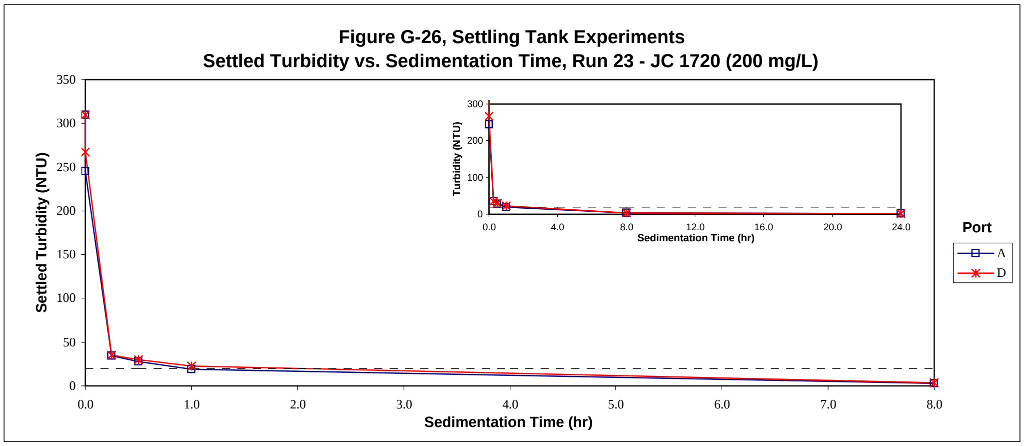


Figure G-26, Settling Tank Experiments
Settled Turbidity vs. Sedimentation Time, Run 23 - JC 1720 (200 mg/L)
Settled Turbidity (NTU)
Sedimentation Time (hr)
Turbidity (NTU)
Port
A
D

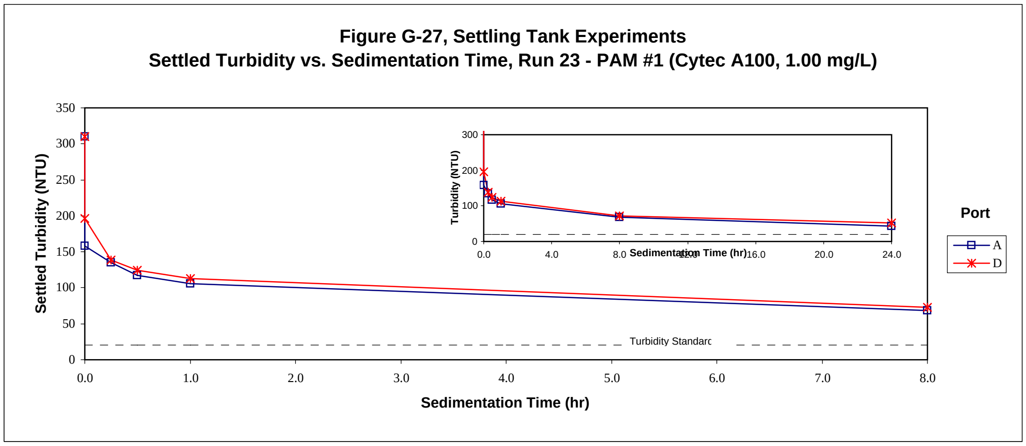


Figure G-27, Settling Tank Experiments
Settled Turbidity vs. Sedimentation Time, Run 23 - PAM #1 (Cytec A100, 1.00 mg/L)
Settled Turbidity (NTU)
Sedimentation Time (hr)
Turbidity (NTU)
Turbidity Standarc
Port
A
D

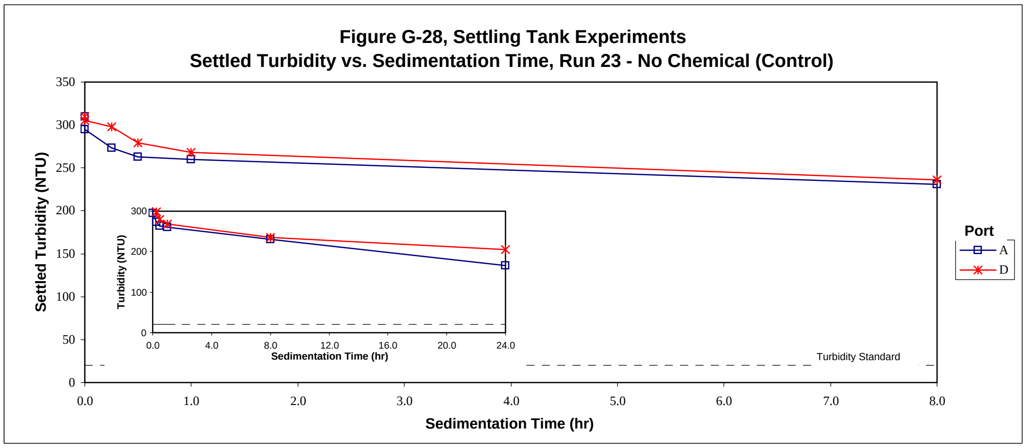


Figure G-28, Settling Tank Experiments
Settled Turbidity vs. Sedimentation Time, Run 23 - No Chemical (Control)
Settled Turbidity (NTU)
Sedimentation Time (hr)
Turbidity (NTU)
Turbidity Standard
Port
A
D